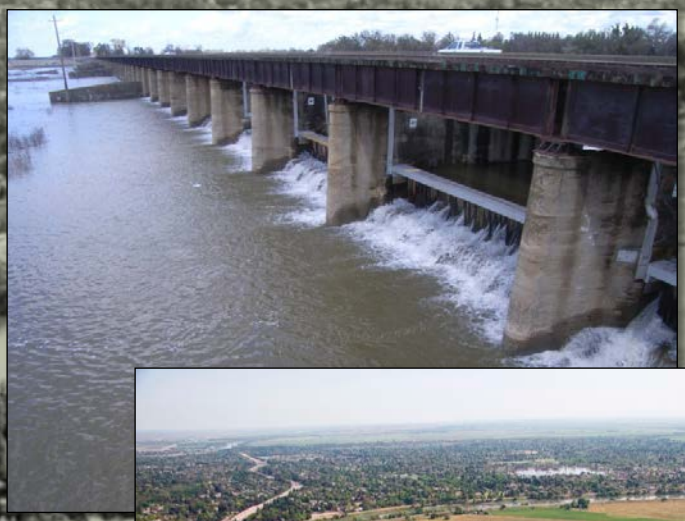
American River Watershed

Common Features
General Reevaluation Report



Appendix A
Plan Formulation

October 2015

Sacramento Area Flood Control Agency

US Army Corps of Engineers ®
Sacramento District

Cover Photos courtesy of the Sacramento District:

Sacramento Weir during operation

Sacramento River facing south near the Pocket and Little Pocket neighborhoods

High flows on the American River at the Highway 160 overcrossing

Folsom Dam releasing high flows

AMERICAN RIVER, CALIFORNIA
COMMON FEATURES PROJECT
GENERAL REEVALUATION REPORT

Appendix A

Plan Formulation

U.S. Army Corps of Engineers
Sacramento District

October 2015

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AMERICAN RIVER, CALIFORNIA
COMMON FEATURES PROJECT
GENERAL REEVALUATION REPORT

TABLE OF CONTENTS

Attachment 1:
American River Common Features
and West Sacramento General Reevaluation Reports Bridging Document

1.0 BACKGROUND

Document Purpose

The purpose of this document is to demonstrate that formulation and identification of the National Economic Development (NED) plans for the American River Common Features (ARCF) and West Sacramento (WS) projects is not affected by investigating the two areas separately. The U.S. Army Corps of Engineers (USACE) is completing General Reevaluation Reports (GRRs) for the ARCF and WS projects. This bridging document accompanies each GRR to explain how the two projects function both independently and together by summarizing the following:

- Existing flood risk management system in the greater Sacramento area
- Flood history of the greater Sacramento urban area
- Future without project conditions for the study area
- Potential system-wide flood risk management alternatives considered
- NED Plan for the ARCF GRR
- NED Plan for the WS GRR
- Effects of Re-evaluating ARCF and WS Projects Separately
- Conclusions

Existing Flood Risk Management System in the Greater Sacramento Area

The city of Sacramento sits along the east bank of the Sacramento River at the confluence with the American River. Immediately across the Sacramento River lies the city of West Sacramento. The cities of Sacramento and West Sacramento are collectively referred to as the greater Sacramento urban area.

Sacramento sits within three distinct basins each protected by a system of levees. The American River South (ARS) basin is protected by 25 miles of levee including the south levee of the American River and the east levee of the Sacramento River. The American River North (ARN) basin is protected by 25 miles of levee including the north levee of the American River, the east levee of the Natomas East Main Drainage Canal (NEMDC), the north and south levee of Arcade Creek, the north and south levee of Dry/Robla Creeks, and the west levee of the Magpie Creek Diversion Channel. The Natomas (NAT) basin is not included in the ARCF GRR.

West Sacramento sits within one distinct basin protected by a system of levees. This basin is split in two by a navigation project. This basin is protected by 50 miles of levee including the west levee of the Sacramento River, the south levee of the Sacramento Bypass, the east levee of the Yolo Bypass, and a canal embankment levee on the south. Refer to Plate 1 for a map of the greater Sacramento urban area.

The Sacramento River comes from the far north portion of California and passes between the cities of Sacramento and West Sacramento. Upstream of the greater Sacramento urban area, major tributaries to the Sacramento River includes the Feather River, the Colusa Basin Drain, and Butte Creek. Within the urban study area, the major tributary is the American River. Up until the flood of 1909, engineers attempted to keep all flow within the Sacramento River. The 1909 flood, along with other floods previously, caused levee failures. After the 1909 flood, the State of California and the Federal government decided to build a bypass system. Over the next 20 years, the bypass system was constructed.

The Sacramento River's bypass system starts approximately 100 miles above the Natomas basin where flow spills out of the Sacramento River to the east upstream of the project levees and into the Butte Basin. Flow in the Butte Basin feeds into the Sutter Bypass. The Sutter Bypass then flows into and across the Sacramento River and is then called the Yolo Bypass. The Fremont Weir sits at the very upper limit of the Yolo Bypass and controls when flow starts to spill into the Yolo Bypass. Continuing downstream, the Yolo Bypass passes just to the west of the city of West Sacramento.

Further down the Sacramento River in the city of Sacramento, the American River comes into the Sacramento River from the east. The Sacramento Weir and Bypass is located approximately three miles upstream of the American River. The primary purpose of the Sacramento Weir and Bypass is to take high flows from the American River over to the Yolo Bypass.

Below the greater Sacramento urban area, the Yolo Bypass and the Sacramento River come back together near the town of Rio Vista. Combined flow then continues out to San Francisco Bay and the Pacific Ocean. Refer to Plate 2 for a map of the Sacramento River Flood Control System.

History of Flooding in the Greater Sacramento Area

The city of Sacramento last flooded in 1909. Folsom Dam and the north levee of the American River, as well as the rest of the Sacramento River Flood Control Project, were all completed by the mid-1950s. 1955 marked a flood of record in the Sacramento Valley. 1964 was also a somewhat significant flood event on the American River. 1986 was a significant flood event that replaced the flood of record. And 1997 was a flood event that was almost as significant as the 1986 event. The 1955, 1964, 1986, and 1997 flood events caused much distress to the levees protecting the greater Sacramento urban area. The main causes of distress included seepage, stability, and erosion. Figure 1 below shows seepage and stability distress on the Sacramento River during the 1986 event that required flood fighting to prevent a full levee breach. Figure 2 below shows erosion distress on the American River that occurred during the 1986 event but was not known about until after flow receded.

For the 1986 flood event, potential levee overtopping became a significant threat on the American River because of Folsom Dam releases having to be ramped up above the objective release of 115,000 cfs and up to 134,000 cfs, which caused flow to be within one foot of the top of levee in certain locations along the American River. Some of these deficiencies have been addressed by seepage and stability improvements authorized in WRDA 1996, WRDA 1999, EWDAA 2004, and WRRDA 2014 for the city of Sacramento as part of the ARCF project, seepage and stability improvements authorized in WRDA 1992 for the city of West Sacramento as part of the WS project, and storage and release improvements

for Folsom Dam authorized in WRDA 1999 and EWDAA 2004. Many deficiencies remain which are the subject of the ARCF and WS GRRs.

Figure 1. Seepage and stability distress in Natomas during the 1986 flood event

Figure 2. Erosion distress on the American River after the 1986 flood event

2.0 FUTURE WITHOUT PROJECT CONDITIONS2.1 Legacy of Historic Levee Construction Techniques

The Sacramento River Flood Control Project, including the portion within the greater Sacramento urban area, was constructed using either a clamshell dredge or a suction dredge retrieving material from the adjacent river and piling it up along the levee alignment. Figures 3 and 4 show typical levee construction by both clamshell dredge and suction dredge methodology.

Figure 3. Typical clamshell dredge levee construction on the Sacramento River system

Figure 4. Typical suction dredge levee construction on the Sacramento River system

The material dredged from the adjacent river was predominately sand with very little silt that tends to be non-cohesive. Additionally, the land on which the levees were constructed tended to be materials similar to the material dredged from the adjacent river. These materials are very poor for levee safety. Water is able to freely move through and under the levee causing severe seepage

problems. Water seeping through the levee tends to carry levee material with it, weakening the levee. Additionally, in much of the study area, the levees have narrower crown widths and steeper side slopes than current engineering standards. In some locations, the waterside slope is steeper than 2 to 1 and the landside slope approaches 1 to 1, which coupled with the nature of the levee fill material, causes a significant stability issue as well.

In addition to the inherent seepage and stability issues of the levees and levee foundations, the potential for an erosion induced levee failure is significant. In many cases, the levees were built somewhat set back from the main channel of the adjacent river. Over the course of about a hundred years, much of the waterside berm left during initial construction has eroded away. This occurred because flow was confined between the levees to much higher stages and velocities than would have occurred prior to the levee construction. In some locations, 100 feet of berm has eroded away making it necessary to armor the waterside levee slope to stop additional erosion into the levee foundation and undermining of the levee. The Sacramento River Bank Protection Project constructs rock riprap bank protection at damaged sites. The problem with this approach is it reacts to erosion after it happens. Erosion has led to partial levee failures at very frequent events.

2.2 Legacy of Historic Levee System Configuration

Reclamation of the Sacramento Valley began around 1850. Up until the flood of 1909, all reclamation activities focused on forcing all flow to be confined to the main rivers. This was a trial and error period with frequent levee failures, including failures in the 1909 event. After this event, the State of California and the Federal Government decided on the need for the bypass system. The State approved the bypass system and the overall Sacramento River Flood Control Project in 1911 and the Federal Government authorized it in 1917. The bypass system and overflow weirs were then constructed over the next 15 years.

The flood of 1909 and a flood that occurred in 1907 were the only significant flood events for which detailed streamflow gage data is available. Initial design of the State and Federally authorized flood control system was developed around the floods of 1907 and 1909. In 1927, a new flood of record occurred for a portion of the Sacramento River system. The larger magnitude flow on these reaches was incorporated into the overall design of the entire flood control system. The entire Sacramento River Flood Control Project was completed in the mid 1950s.

In 1955, a new flood of record occurred for the entire Sacramento River system. This flood event caused a levee failure that inundated Yuba City, as well as a few other levee failures into relatively rural areas. Another flood event occurred in 1964 that was more substantial than every other event that occurred prior to the 1955 event. In 1986, again a new flood of record occurred for the entire Sacramento River system. This flood event caused a levee failure that flooded smaller communities around the City of Marysville, as well as a few other levee failures into relatively rural areas. In 1997, a flood event occurred that was nearly as significant as the 1986 event. This flood event caused a levee failure that nearly flooded the small community of Meridian, as well as a few other levee failures into relatively rural areas.

With the increasing size and frequency of storms since the mid 1950s, the levee system has been stressed by conveying more flow than it was intended to convey. This has partially been mitigated by the construction of various reservoirs around the Sacramento Valley. However, there are numerous

unregulated tributaries that contribute flow to the Sacramento River system. Therefore, the effect the reservoirs have on attenuation of flow in the Sacramento River system is minimal.

2.3 Prior Decisions on Folsom Dam

The 1986 flood event nearly caused the inundation of the cities of Sacramento and West Sacramento. After this event, the Corps was directed to complete a feasibility study to identify Federal interest in flood risk reduction measures. For American River, studies were completed in 1991 and 1996, with each identifying a new dam to be constructed on the north fork of the American River near the town of Auburn, plus levee improvements in the greater Sacramento area, as the NED plan. For various reasons, Congress chose not to authorize Auburn Dam and instead authorized modifications to Folsom Dam.

The Folsom Dam Modifications and Raise Projects are intended to control a 200-year flood event with a peak release of 160,000 cfs. The current objective release from Folsom Dam is 115,000 cfs. The original intent was to modify the existing Folsom Dam to be able to accomplish this higher objective release, however, due to technical complexities, it was decided to build an auxiliary spillway and control structure to accomplish this. This project is also combined with a USBR dam safety project and is therefore referred to as the Folsom Dam Joint Federal Project (JFP).

Prior authorizations in WRDA 1996, WRDA 1999, and EWDAA 2004 for the ARCF project were intended to improve the conveyance capacity of the levee system in the greater Sacramento area to safely convey the new release of 160,000 cfs. The 1997 flood event along with subsequent investigation combined with Hurricane Katrina, the inundation of New Orleans, and subsequent investigation have all illustrated that much more work needs to occur to the levee system protecting the greater Sacramento urban area.

2.4 General Problem Identification for the Greater Sacramento Urban Area

There are four main problems with the levee system for the greater Sacramento urban area: seepage, stability, erosion, and height. In general, three of these problems are a result of levee construction techniques (seepage, stability, and erosion). The other problem (height) is a result of the design conveyance capacity of the overall Sacramento River system based primarily on the 1907, 1909, and 1927 flood events.

Levee Construction Technique Problems

Seepage: Water traveling through and/or under a levee carries soil particles with it, greatly weakening the entire structure. If this condition is not corrected, it will likely lead to a levee failure. Even with flood fighting efforts, this condition occasionally leads to a levee failure. Figure 5 below shows a general seepage condition on the Sacramento River system.

Stability: Because the levees are built out of relatively non-cohesive materials (sand), and are in general built to a poor geometry, stability problems cause much distress in flood conditions. Like seepage, if this condition is not corrected, it will likely lead to a levee failure. Figure 6 below shows sloughing of a levee as a result of stability problems.

Figure 5. General seepage condition on the Sacramento River system

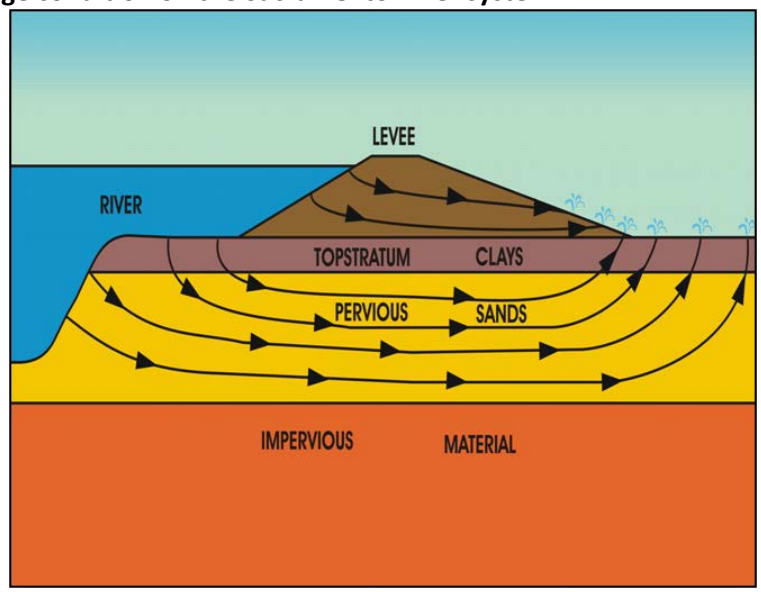


Figure 6. Sloughing of levee slope as a result of stability problem

Erosion: Because the levees are built out of relatively non-cohesive materials (sand), and are subjected to very severe (12 feet per second) river currents in some cases, erosion of the berm and levee slope is an ongoing concern. When erosion is occurring during a flood event, it is not evident and does not become evident until a full levee failure is in progress. Figure 7 below shows erosion on the Sacramento River at a site in the city of Sacramento.

Levee System Configuration Problem

The Sacramento River and Yolo Bypass combined were designed to convey 469,000 cfs, based primarily on the floods of 1907, 1909, and 1927. In 1986, that flow was exceeded by over 100,000 cfs. The American River was designed to convey 115,000 cfs. This amount was based on the hydrology used to design Folsom Dam and the north levee of the American River in the late 1940s. In 1986, there was

nearly 20,000 cfs more than that amount in the American River. The 1986 flood event was approximately an 80-year event.

The 1986 and 1997 flood events each stressed the levee system for the greater Sacramento urban area beyond what it was intended to convey. With the urbanization of the greater Sacramento urban area, the design conveyance capacity past the cities is insufficient to minimize the risk of catastrophic flood damages.

Figure 7. Erosion of the levee slope on the Sacramento River.

2.5 General Probability of Levee Failures into the Cities of Sacramento and West Sacramento

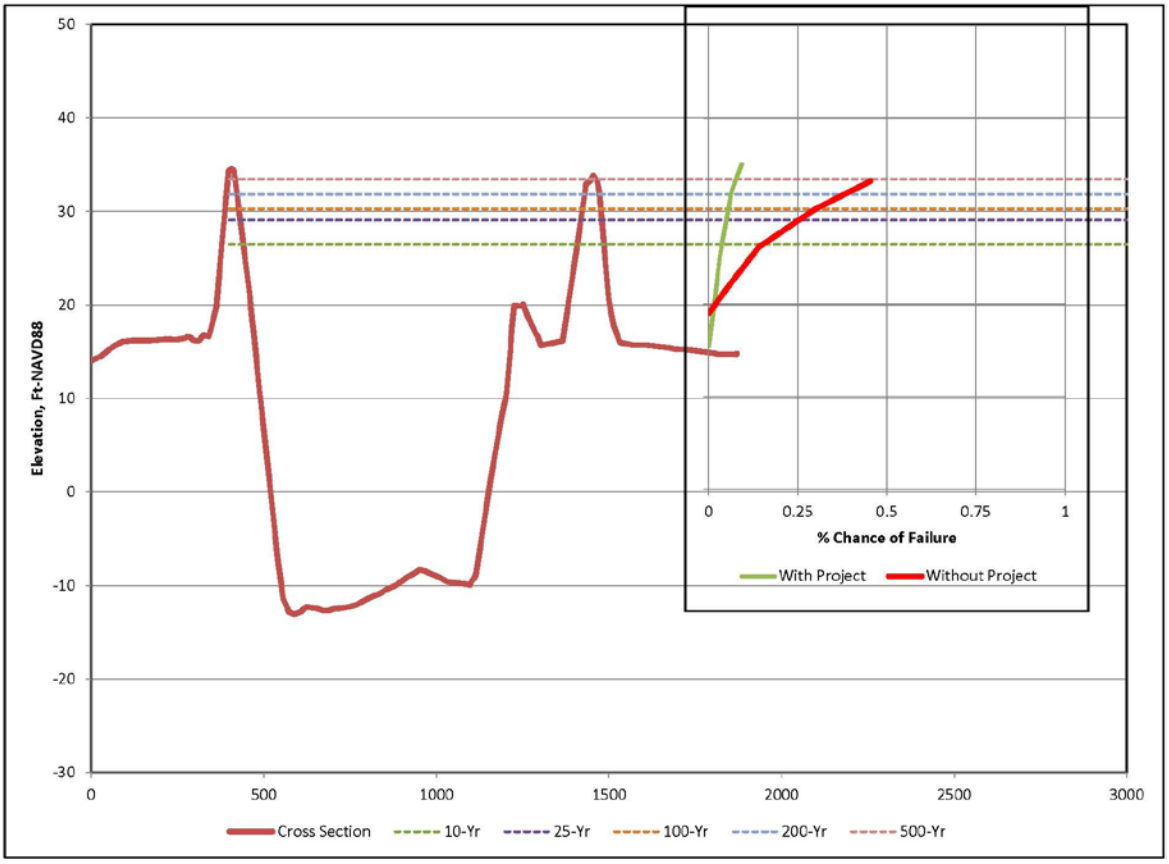
The GRRs for both ARCF and WS have been developed using consistent methodology and tools. For hydrology, both studies are using the updated Sacramento/San Joaquin Rivers Comprehensive Study hydrology. For hydraulics, both studies are using a HEC-RAS model of the entire Sacramento River Flood Control Project. For geotechnical, both studies are using accepted seepage and stability model software with inputs based on site specific geotechnical explorations. For risk analysis and economics, both studies are using the HEC-FDA software. For cultural resources, environmental, real estate, and civil design, methodologies are the same between the two studies.

The analysis for both studies has calculated water surface elevations for various frequency events along all levees adjacent to the greater Sacramento urban area. The analysis for both studies has also developed levee performance curves for typical reaches within each city.

Figure 8 below shows a cross section of the Sacramento River in the Pocket Area of Sacramento, along with the levee performance curve for that location. In the cross section, Sacramento is to the left side of the left levee and channel and West Sacramento is to the right side of the right levee and channel. Also shown on the cross section is the calculated water surface elevation for a 10-, 25-, 100-,

200-, and 500-year event. Elevations on the levee performance curve are at the same level as the cross section so that the water surface elevations in the channel can be compared to the levee performance curve.

Figure 8. Cross Section of the Sacramento River in the Pocket Area Along With the Levee Performance Curve for that Location



Based on this graphic, it can be seen that the 10-year water surface elevation has approximately a 15% chance of causing a levee failure into Sacramento. For the 25-, 100-, 200-, and 500-year events, the chances of have a levee failure into the city is 25%, 30%, 40%, and 45% respectively.

The without project condition levee performance curve is a composite curve that includes a component for through and under seepage, stability, and judgment. At this particular location, through seepage is not a concern because a shallow seepage cutoff wall was constructed there in the early 1990s. Additionally, stability in general is not a concern because of the presence of this same wall. Therefore, the drivers for the levee performance curve at this particular location are underseepage and judgment. Between the two, approximately 60% of the risk is driven by judgment and 40% is driven by underseepage. Judgment is a composite curve representing risk from vegetation, encroachments, rodent activity, access, and erosion. The risk from each of these components is significant but the single largest driver of the judgment curve is erosion.

The levee performance curve shown above is for the Sacramento side of the Sacramento River. The levee performance curve for the West Sacramento side of the river is very similar. Therefore, relative risk of levee failure is similar for West Sacramento as it is for Sacramento.

3.0 SYSTEM-WIDE IMPROVEMENT ALTERNATIVES

System-wide flood risk management alternatives for the Sacramento River were evaluated to determine if they would provide a cost-efficient solution without levee improvements for individual basins in the greater Sacramento urban area. Following is a brief description of each of the system-wide alternatives considered, the flood risk reduction effects of each alternative, and the reason each alternative was excluded from further consideration.

American River Upstream Storage

Studies completed in 1991 and 1996 identified Auburn Dam as the NED Plan to address flooding on the American River. Auburn Dam would be able to control a much larger flood event than Folsom Dam alone and would provide a higher level of flood risk reduction to the greater Sacramento urban area.

For Auburn Dam to be effective, the combined objective release from Auburn and Folsom Dams would need to be maintained at 115,000 cfs to leave storage available for the flood peak in each reservoir. With an objective release of 115,000 cfs, almost all of the levee improvements included in the NED Plans for both the ARCF and WS GRRs would still be necessary because the existing levee system is unreliable even at relatively low flow stages above the levee toe.

Specific levee improvements that would be required in conjunction with Auburn Dam include all seepage and stability improvements, all of the levee raising, probably the Sacramento Weir and Bypass widening, and almost all of the erosion protection improvements included in the ARCF and WS TSPs. Additionally, levee raising along the Sacramento River and Yolo Bypass would be required to protect against upstream Sacramento River driven floods of similar magnitude as Auburn Dam would be designed to control (approximately 400-year level of performance as identified in the 1996 report). This levee raising, possibly coupled with widening the Sacramento Weir and Bypass would be beyond the level needed for the two NED Plans because it would need to convey a 400-year flood event from the Sacramento River as opposed to an approximately 200-year event, which is the level of the NED Plans.

This alternative was excluded from further consideration in the GRRs because it would require almost all (if not all) of the features of both NED Plans. The levee improvements in the greater Sacramento urban area and the conveyance improvements of widening the Sacramento Weir and Bypass are required components of a comprehensive flood risk reduction alternative involving upstream storage on the American River and are therefore “no regrets” features. The currently proposed levee and conveyance improvements would be necessary and would provide benefits whether or not additional upstream storage is constructed in the American River watershed.

Transitory Storage In Rural Basins Upstream of the Greater Sacramento Urban Area

A possible way to improve flood risk for the greater Sacramento urban area is to temporarily store flood volume in some of the rural area adjacent to the Sacramento River, the Feather River, the Yolo Bypass, and/or the Sutter Bypass.

This temporary or transitory storage has the effect of reducing water surface elevations at the northwest corner of Natomas for various frequency events by between 2 and 3 feet. Further down the Sacramento River and Yolo Bypass, this decrease in stage reduces to zero, essentially giving no benefit to most of the greater Sacramento urban area. There are two primary reasons why this is the case. First, there is a tremendous volume of water coming down the Sacramento Valley towards the greater Sacramento urban area and when a basin is used for temporary storage, the volume of water taken out of conveyance in the river channels and put into storage is relatively small and insignificant. Second, the contribution of the Folsom Dam flood releases being conveyed down the American River eliminates any small decrease in stages that might have been experienced by transitory storage.

Therefore, with transitory storage, all of the levee improvements included in both NED Plans for ARCF and WS are still necessary, with transitory storage not providing nearly enough economic benefit to justify the very large cost. Therefore, transitory storage was excluded from further consideration.

Yolo Bypass Widening and Conveyance Capacity Improvements

Another possible way to reduce flood risk for the greater Sacramento urban area is to improve the amount of conveyance and the reliability of conveyance of the Yolo Bypass. This alternative would likely include widening the Yolo Bypass by setting back the east levee from Fremont Weir down to the Sacramento Bypass, widening the Fremont Weir, removal of embankment within the bypass at the Yolo Shortline Railroad, the Union Pacific Railroad, and Interstate Highway 80, construction of a diversion structure from the Yolo Bypass into the Sacramento River Deep Water Ship Channel (DWSC), construction of a closure structure on the DWSC, and construction of seepage and stability improvements of all of the existing levees along the bypass.

Yolo Bypass conveyance improvements have the effect of reducing water surface elevations at the northwest corner of Natomas for various frequency events by up to 3 feet. Further down the Sacramento River and Yolo Bypass, this decrease in stage reduces to nearly zero, essentially giving no benefit to most of the greater Sacramento urban area. The primary reasons why there is not more of a stage reduction is the same as for the transitory storage alternative.

Therefore, with Yolo Bypass conveyance improvements, all of the levee improvements included in both TSPs for ARCF and WS are still necessary, with Yolo Bypass conveyance improvements not nearly providing enough economic benefit to justify the very large cost. Therefore, for purposes of these two studies, it was screened out. It is important to note that the Yolo Bypass widening does potentially provide benefits elsewhere and is being looked at by the State of California as part of the Central Valley Flood Protection Plan (CVFPP), and this feature is still being analyzed by others but would not affect (strand)levee improvement in the greater Sacramento urban area.

Reoperation of Upstream Reservoirs

Another possible way to reduce flood risk for the greater Sacramento urban area is to reoperate upstream reservoirs to provide more flood flow attenuation within existing reservoirs. There are three

main reservoirs upstream of Folsom Dam that are intended for hydropower, including Union Valley, French Meadows, and Hell Hole, that could be reoperated for flood flow attenuation. Surrounding the Sacramento Valley to the north of the greater Sacramento urban area, Shasta, Oroville, Bullards Bar, Englebright, and Black Butte are all reservoirs that have some flood flow attenuation but also have a water supply and hydropower component; some of the water supply and hydropower storage space could be converted to flood flow attenuation at these reservoirs as well.

On the American River, the three hydropower reservoirs are relatively small compared to Folsom Dam. Therefore, unless significant storage space was to be converted to flood control, very little benefit is provided by reoperation of these reservoirs.

On the Sacramento River to the north, as pointed out in a previous section, there are many tributaries to the Sacramento Valley that are unregulated. Therefore the effect of reoperation of the existing reservoirs is quickly made irrelevant as the non-regulated streams and rivers contribute flow to the Sacramento Valley.

Therefore, with reoperation of upstream reservoirs, all of the levee improvements included in both NED Plans for ARCF and WS are still necessary, with reoperation of these reservoirs not providing nearly enough economic benefit to justify the very large cost. Therefore, the reoperation of upstream reservoirs was excluded from further consideration.

Overall Conclusions of System-Wide Improvement Alternatives

Every system-wide improvement alternative has minimal to no impact on stage reduction in the greater Sacramento urban area and requires almost all (if not all) of the levee improvements included in each of the NED Plans in order to significantly reduce the flood risk for the greater Sacramento urban area. Consequently, levee improvements in the greater Sacramento urban area are a first increment to any system-wide improvement plan. The State of California is formulating the "Central Valley Flood Protection Plan" (CVFPP) which is considering some or all of these system-wide plans. For purposes of their plan formulation efforts, they consider the levee improvements in these two GRRs to be "early implementation projects" and necessary integral increments to the overall CVFPP.

In Figure 8 above, if the water surface elevations were dropped by a half of foot on the stage reduction (which is an upper limit at this location as a result of the system-wide alternatives considered), very little risk reduction is provided to the greater Sacramento urban area. Therefore, the conclusions from evaluation of the system-wide alternatives are: 1) There is not a system-wide alternative that alone significantly reduces the flood risk to the greater Sacramento urban area; 2) Any system-wide plan still requires levees to be improved so that they can more reliably convey even moderate flows; and 3) Almost all of the levee improvements proposed in the ARCF and WS GRRs are integral to any system-wide plan that may be implemented in the future.

4.0 AMERICAN RIVER COMMON FEATURES NED PLAN AND LPP PLAN

After the system-wide plans were determined to alone not significantly reduce flood risk for the Sacramento urban area, levee improvements within the urban area were determined to be required for significant flood risk reduction. The NED Plan and a Locally Preferred Plan (LPP) were identified with the most substantial difference between the two being inclusion of a widened Sacramento Weir and Bypass

in the LPP but not the NED Plan. Following are details of the NED Plan for the ARCF GRR, identified by basin.

American River South (ARS) Basin

- Sacramento River: Approximately 9 miles of seepage cutoff walls, 2.5 miles of geotextile stabilized slope, 2 miles of slope flattening, 10 miles of rock riprap protection, and 9 miles of levee raising will be constructed.
- American River: Approximately 7 miles of rock riprap protection will be constructed.

American River North (ARN) Basin

- American River: Approximately 4 miles of rock riprap protection will be constructed.
- Natomas East Main Drainage Canal (NEMDC): Approximately 1 mile of seepage cutoff walls will be constructed.
- Arcade Creek: Approximately 4 miles of seepage cutoff walls, 4 miles of geotextile stabilized slope, and 4 miles of existing floodwall will be raised.
- Magpie Creek Diversion Channel: Approximately 0.5 miles of the Magpie Creek Diversion Channel west levee will be raised and the levee will be extended approximately 1,000 feet upstream.

For the NED plan, specific locations for the seepage, stability, erosion, and overtopping improvements for both basins are shown on Figure 9 below. Figure 8 above shows the with-project levee performance curve, and by comparing to the without project condition curve, the relative risk reduction provided by the plan features can be seen.

Following are details of the LPP for the ARCF GRR, identified by basin.

- Sacramento River: Construction of about 9 miles of slurry cutoff walls and about 10 miles of rock bank protection along the Sacramento River east levee, as well as about 2.5 miles of geotextile stabilized slope, 2 miles of slope flattening, and less than 1 mile of levee raise.
- Eastside Tributaries: Construction of about 4 miles of slurry cutoff walls and 4 miles of levee raises along the NEMDC and Arcade Creek levees.
- American River: Construction of rock bank protection and launchable rock trenches along 4 miles of the north bank and 7 miles of the south bank of the American River.
- Sacramento Bypass: Widen the Sacramento Weir and Bypass by 1,500 feet.

For the LPP, specific locations for the seepage, stability, erosion and overtopping improvements for both basins along with the widening of the Sacramento Weir and Bypass are shown on Figure 10 below.

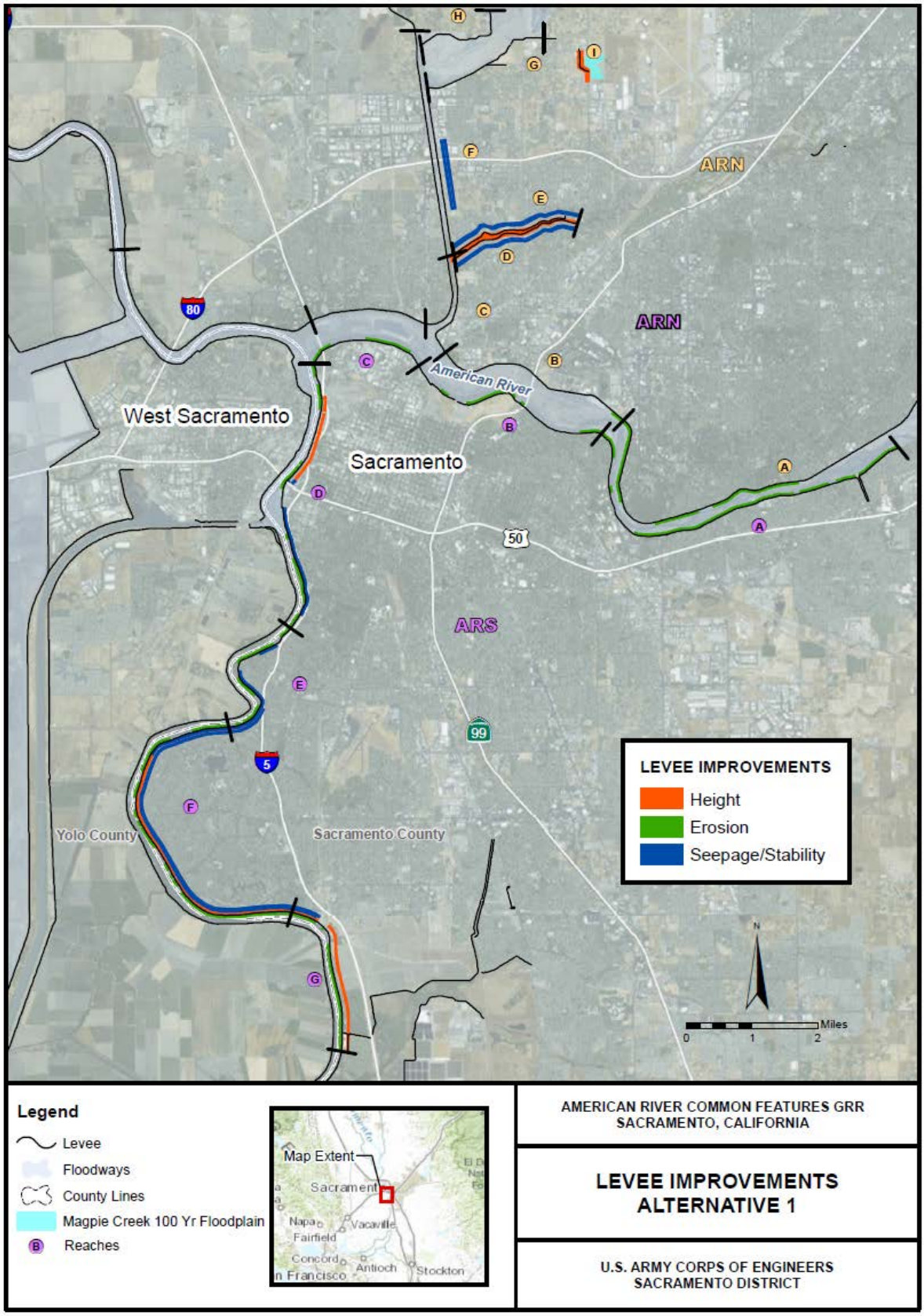


Figure 9. NED Plan Features for the American River Common Features GRR

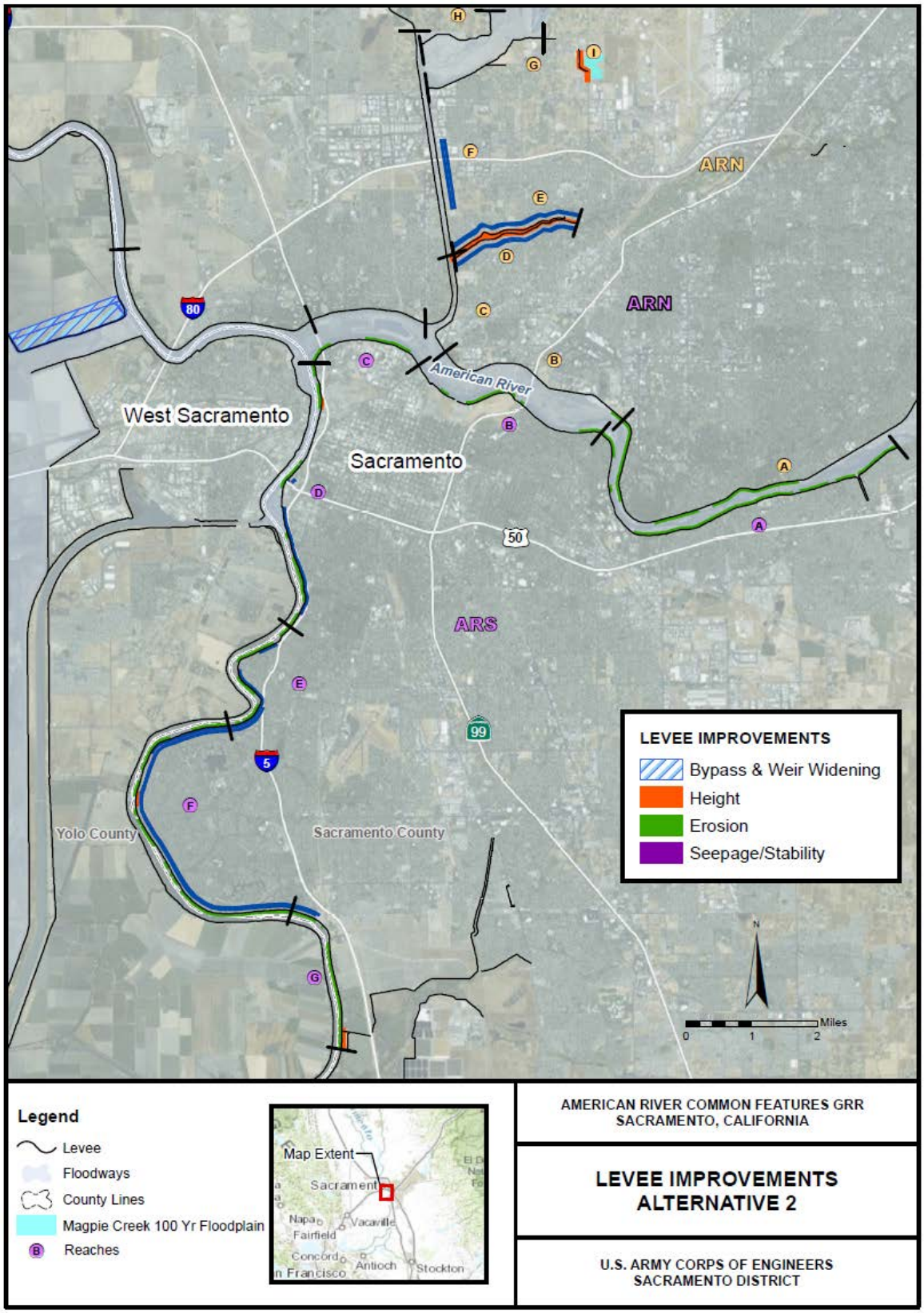


Figure 10. LPP Plan Features for the American River Common Features GRR

5.0 WEST SACRAMENTO NED PLAN

After the system-wide plans were determined to alone not significantly reduce flood risk for West Sacramento, levee improvements within the city were determined to be required for significant flood risk reduction. Alternatives for West Sacramento included improvement of the existing levees, construction of setback levees, construction of a widened Sacramento Bypass and Weir, construction of a diversion structure from the Yolo Bypass into the Deep Water Ship Channel, and construction of a Deep Water Ship Channel Closure Structure. Following are details of the NED Plan for the WS GRR, identified by basin. For West Sacramento, the NED Plan is also the TSP.

West Sacramento North Basin

- Sacramento River: Approximately 6 miles of rock riprap protection will be constructed.
- Yolo Bypass: Approximately 1 mile of seepage cutoff walls will be constructed.
- Port of Sacramento: The obsolete navigation lock from the DWSC to the Sacramento River will be removed and the Sacramento River west levee between the north and the south basins will be made continuous.
- Sacramento Bypass: Approximately 3,000 feet of rock riprap protection will be constructed.

West Sacramento South Basin

- Sacramento River: Approximately 6 miles of setback levee with seepage cutoff walls will be constructed.
- Port of Sacramento: Approximately 1,000 feet of seepage cutoff walls will be constructed. Also, the obsolete navigation lock from the DWSC to the Sacramento River will be removed and the Sacramento River west levee between the north and the south basins will be made continuous.
- Sacramento River DWSC: Approximately 1 mile of seepage cutoff walls will be constructed.
- Yolo Bypass: Approximately 5 miles of seepage cutoff walls and 19 miles of rock riprap protection will be constructed.
- South Cross Levee: Approximately 1 mile of relief wells and 0.2 miles of stability berm will be constructed.

Specific locations for the seepage, stability, and erosion improvements for both basins are shown on Figure 11 below.

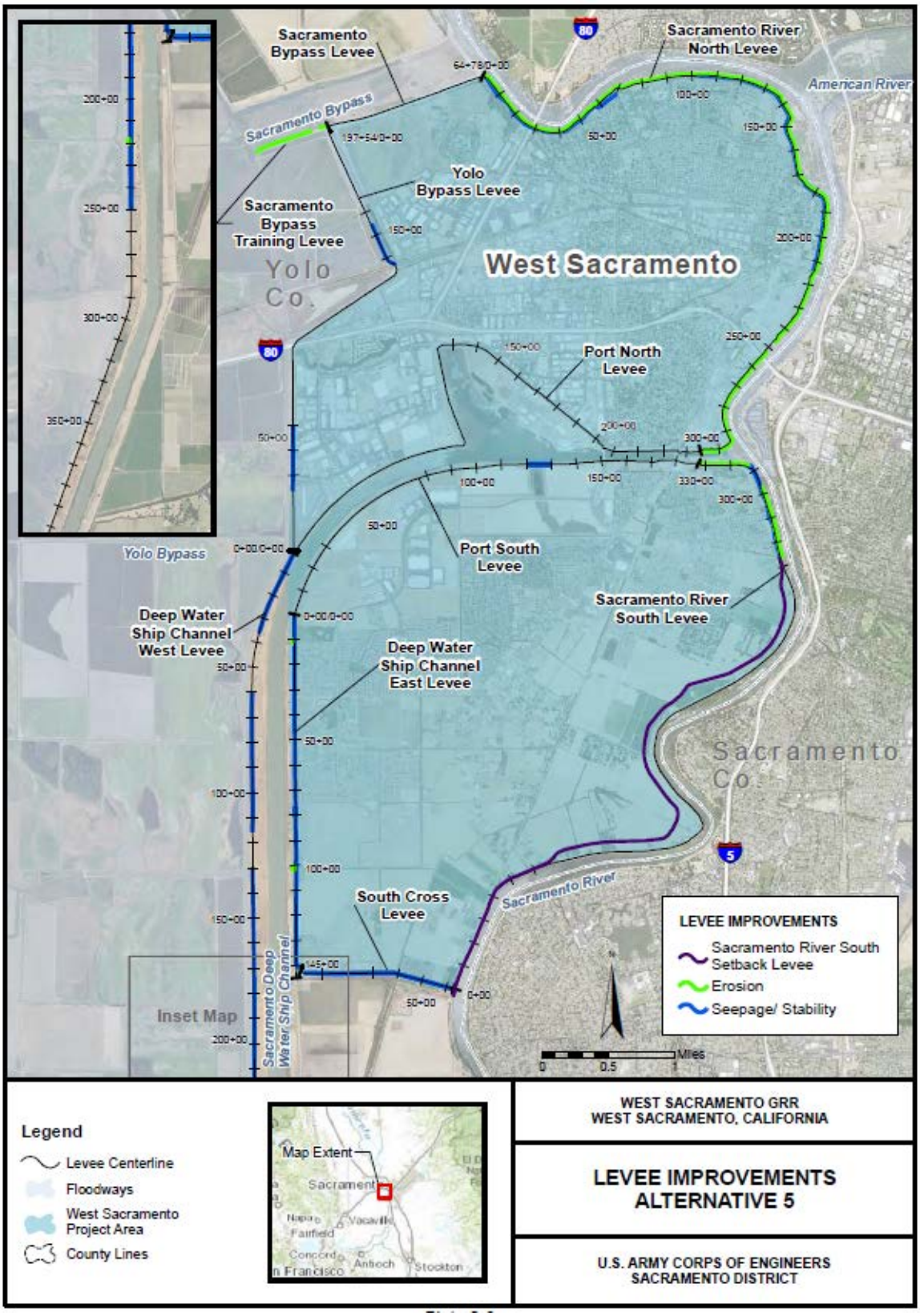


Figure 11. TSP Recommended Features for the West Sacramento GRR

6.0 EFFECTS OF RE-EVALUATING ARCF AND WS PROJECTS SEPARATELY

To determine the effects of improving levees in various basins, hydraulic analysis of the ARCF and WS study areas was performed as follows: (1) without project conditions for Sacramento and West Sacramento; (2) system-wide plans were developed and screened because they did not significantly reduce the flood risk of the two cities; (3) the ARCF TSP was considered in place but not the WS TSP; (4) the WS TSP was considered in place but not the ARCF TSP; and (5) the two TSPs were evaluated together. Details of this hydraulic analysis can be found in the Hydraulic Attachment to the Engineering Appendix for each of the two GRRs.

Step (1) in the above process confirmed the existing flood risk of the two cities as described in the background presented previously in this document. Step (2) established that there is no system-wide plan that has a significant effect on flood risk reduction in Sacramento and West Sacramento; therefore, system-wide plans were screened out. Plan formulation then proceeded to evaluate flood risk reduction measures within both cities. In carrying out steps (3), (4), and (5), it became clear that it does not matter whether the two cities are evaluated separately or together, the identification of the NED Plan would be the same

USACE engineering and economics models were used to evaluate without- and with-project conditions for each of the four hydraulic basins in the ARCF and WS study areas. Due to the practical limitations of models, the use of simplifying methods is necessary in representing the complexities of the real world. One of those methods is to evaluate each hydraulic basin separately from other basins whether those other basins are part of the same study or not. In the evaluation of each basin, it is assumed that there are no failures of levees in other basins under both without- and with-project conditions. Consequently, the proposed strengthening of an existing levee in any basin is assumed to have no effect on the probability of a levee failure in any other hydraulic basin, whether the other basin is part of the same study or not.

There is both empirical and analytical support for the assumption that there are no levee failures in other hydraulic basins. Since completion of the Sacramento River Flood Control Project in the mid 1950s, levee failures have occurred during the 1955,1983, 1986, and 1997 flood events. Detailed streamflow data necessary to determine the effect of the levee failure on stage reduction in the greater Sacramento urban area is only available for the 1997 event. An analysis was performed on the 1997 event to determine effect of the levee failures. This analysis showed that the levee failures on the Sutter Bypass and the Feather River reduced the highest stage recorded at the very upper limit of the Natomas Basin by 0.4 feet, and that reduction tapered down to zero further south within the cities of Sacramento and West Sacramento. The limited reduction in stage was due in part to the levee failures occurring near the peak of the flood. Also, the American River flows overwhelmed any minimal reduction in the Sacramento River stage that might have otherwise reached the Sacramento urban area. The levee failures that occurred during 1955, 1983, and 1986 all occurred around the peak of the flood and therefore would have resulted in similar minimal reductions in stage in the Sacramento urban area.

Analysis was performed to estimate the potential risk reduction on one side of the Sacramento River if the levee failed on the other side of the river. The specific analysis considered a levee failure into the city of Sacramento and what the stage reduction would be affecting West Sacramento. The analysis estimated that there is a 0.4 foot of stage reduction. The analysis assumed that the failure started to occur slightly before the peak of the hydrograph and developed rapidly. Actual levee failures

have happened very near the peak or somewhat after the peak and have taken considerable time to develop to their full width. Therefore, the estimate of 0.4 foot is likely an upper limit.

If the worst case scenario occurred with a breach sufficiently before the peak to lead to a 0.4 foot stage reduction, the probability of a levee failure on the West Sacramento side of the river would be reduced from 23% to 18%. Because there is only a 39% chance of levee failure on the Sacramento side during a 1 in 200 (0.5%) AEP event under without-project conditions, strengthening the levee on only the Sacramento side would have an insignificant effect on expected flood damages on the West Sacramento side. For smaller, more frequent flood events, the effect of a levee failure on flood stages, and consequently on the probability of a levee failure on the opposite bank, would be even less. If the period of time before the West Sacramento levee was also strengthened was relatively short (e.g., 10 years or less), the chance of a significant flood event occurring during that period would be minimized, and the already insignificant increase in expected flood damages in West Sacramento would be even further reduced. In the reverse scenario, a single levee failure on the West Sacramento side during a 1 in 200 ACE event under without-project conditions (which has a probability of only 23%) would cause a stage reduction of about 0.4 foot, and the probability of a levee failure on the Sacramento side of the river would then be reduced from 39% to 37%. Because three low probability events are involved, strengthening the levee on only the West Sacramento side would have an insignificant effect on the expected flood damages on the Sacramento side, particularly over a relatively short period of time.

To determine the effect of re-evaluating the ARCF and WS projects separately, hydraulic analysis of the two project areas was performed in three ways: (1) without-project conditions; (2) the two TSPs were evaluated separately; and (3) the two TSPs were evaluated together. Comparison of those three scenarios indicated that combining the two projects would not result in the selection of different plans (Tech Memo, Common Features GRR and West Sacramento GRR TSP Comparison, 16 October 2014).

Table 1: Tentative Regional Construction Sequence for ARCF and West Sacramento.

REGIONAL PRIORITY	WATERWAY	REACH	YEAR OF PROJECT CONSTRUCTION										
			1	2	3	4	5	6	7	8	9	10	11-17
1	JFP/Dam Raise												
2	ARCF Sacramento River	ARS F											
3	ARCF Sacramento River	ARS E											
4	ARCF American River	ARS A											
5	WS Yolo Bypass Levee												
6	ARCF Sacramento River	ARS G											
7	ARCF Sacramento River	ARS D											
8	ARCF American River	ARS B											
9	ARCF American River	ARN A											
10	ARCF American River	ARS C											
11	ARCF American River	ARN B											
12	ARCF Sac Weir & Bypass	--											
13	WS Sacramento River North												
14	WS Port North Levee												
15	WS Sac Bypass Training Levee												
16	WS Sacramento River South												
17	WS Port South Levee												
18	ARCF Arcade Creek	ARN D											
19	ARCF NEMDC	ARN F											
20	ARCF Arcade Creek	ARN E											
21	ARCF NEMDC	ARN C											
22	ARCF Magpie Creek	ARN I											
23	WS Deep Water Ship Ch. East												
24	South Cross Levee												
25	WS Deep Water Ship Ch. West												

7.0 CONCLUSIONS

There is no system-wide flood risk management alternative that would avoid the need for levee improvements in the ARCF and WS project areas. The effect of levee improvements in one of the four hydraulic basins in the ARCF and WS project areas on any other basin is insignificant relative to plan formulation or implementation. Consequently, combining all four hydraulic basins into a single evaluation rather than two evaluations would not change the plan formulation process or identification of the NED plan for either project.

Attachment 2: DEVELOPMENT OF COSTS AND BENEFITS FOR THE FOCUSED ARRAY OF ALTERNATIVES

COST BASIS FOR FOCUSED ARRAY OF ALTERNATIVES

This document describes the basis for the costs estimates for the alternatives identified in Table 3-14 of the GRR.

The alternatives included in the focused array are effectively building blocks that start with fixing levees. It was determined that to reduce the flood risk for the City of Sacramento, fixing the levees is the first increment.

Alternative 0.5: Alternative 0.5 included improvements to the levees protecting Sacramento to address seepage, stability, and erosion. Levee raising or other conveyance improvements were not included in this alternative. This alternative provides somewhere around a 1/100 ACE performance before overtopping would occur. The cost estimate for this alternative is the Alternative 1 cost estimate from the 2013 time frame (2012 price levels) with the quantities and cost for levee raising removed. The total cost for this alternative at this level of analysis was $1,262,915,000. The cost for Alternative 1 is shown in the following Table 1. The reduction of Alternative 1 costs as a result of removing the levee raising on the Sacramento River and the Natomas Basin is shown on Table 2. The costs as shown on Table 2 included with the total cost of the additional levee improvement construction is shown on Table 3. Table 3 also includes supporting economic information (interest during construction and average annual costs).

Alternative 1: Alternative 1 adds levee raising to the previous alternative and got to approximately a 1/200 ACE level of performance. There is a spreadsheet estimate for this alternative in 2012 price levels that is the basis of the cost estimate in Table 3-14. That estimate is included in the following Table 1. The total cost for this alternative at this level of analysis was $1,426,055,000.

Alternative 2: Alternative 2, includes the levee improvements described in Alternative 1 and adds widening of the Sacramento Weir and Bypass which negates the need to include most of the levee raising in Alternative 1. It accomplishes this by rerouting flow that would have gone down the Sacramento River instead to the widened Sacramento Weir and Bypass. A spreadsheet estimate for this alternative in 2012 price levels is the basis for the cost estimate in Table 3-14 and is also included in the following Table 4. The total cost for this alternative at this level of analysis was $1,567,746,000. Supporting economic information (interest during construction and average annual costs) are shown on Table 5.

Alternative 3: Alternative 3 includes the levee work and widening of the Sacramento Weir and Bypass described in Alternative 2, and then adds the I Street Diversion Structure which negates the need to do all levee raising work on the Sacramento River, plus most of the erosion, seepage, and stability work downstream of the Diversion Structure. Diverting this much flow from the Sacramento River into the Sacramento Weir/Bypass and into the Yolo Bypass had very severe impacts. The hydraulic impacts to the Yolo Bypass were large and it was obvious that many features would need to be added to mitigate for the effects. The cost includes the cost of Alternative 2 with all of the work for ARS Reaches D-G removed, , plus the cost of Yolo Bypass mitigation features, approximately estimated at $1,131,880,900

(shown on Table 8), and the cost of the I-Street Diversion structure itself at $122,161,763 (shown on Table 9). The total cost for the alternative is $2,122,000 and is shown in Table 6. This alternative did not have the support of the environmental community or the local partners and stakeholders. Once it was shown that Alternative 3 was not on the rising limb of the net benefits curve, no further effort on this alternative was performed.

Alternative 4: Alternative 4 added Auburn Dam to the levee improvements proposed in Alternative 1. This feature did not negate the need to do any of the levee improvements in Alternative 1. The cost estimate developed for Auburn Dam in 1996 was inflated to 2014 dollars, and added to the cost of Alternative 1. The benefit provided by including Auburn Dam would be that instead of the overall project providing approximately a 1/200 ACE-year level of performance, it would provide approximately a 1/400 ACE-year level of performance. The cost of Auburn Dam, inflated from 1996 to 2014 is approximately $1,800,000,000. It does provide additional benefits beyond Alternative 1, however not enough to keep it on the rising limb of the net benefits curve. Moving forward with the TSP does not preclude the possible future justification of Auburn Dam; the features of the TSP are no-regrets actions with regards to the possibility of Auburn Dam ever being built. Once it was shown that Auburn Dam was not on the rising limb of the net benefits curve, no further effort on this alternative was performed. The total cost for Alternative 4 is shown on Table 10.

Alternative 5: This alternative was developed to show a maximum level of flood risk reduction for the City of Sacramento. It basically includes all building block steps including levee improvements from Alternative 1, the Sacramento Weir and Bypass widening of Alternative 2, the I Street Diversion Structure from Alternative 3 (including the Yolo Bypass mitigation work), and the Auburn Dam from Alternative 4. Taking the cost of all of these features and adding them together is the background for the cost of this alternative. The total cost for Alternative 5 is shown on Table 11.

Alternative 6: This alternative is non-structural and therefore there is no significant cost, but also no significant flood risk reduction.

The analysis conducted on the Focused Array of Alternatives displayed that Alternatives 1 and 2 would be the most efficient alternatives and would be carried forward for further analysis. This further analysis is shown in the GRR in the tables following Table 3-14. Additionally, the costs for these alternatives were updated to reflect 2015 price levels.

Cost and associated economic information is shown on Table 12.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

CECW-SPD

OCT 30 2014

MEMORANDUM FOR THE ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)

SUBJECT: American River Common Features (ARCF) Project, California, Deviation from the National Economic Development (NED) Plan

1. PURPOSE: To request that you grant an exception to the requirement to recommend the NED plan. The exception would allow the U.S. Army Corps of Engineers (USACE) to recommend the Locally Preferred Plan (LPP) for flood risk management for the American River Common Features General Reevaluation Study.

2. BACKGROUND: The Sacramento District and South Pacific Division have completed the Tentatively Selected Plan milestone. The district has resolved legal, policy and technical issues raised by the District Support Team and Office of Water Project Review. HQUSACE policy and legal review of the LPP Exemption Request is complete and we support the request to allow a recommendation that deviates from the NED plan.

3. DISCUSSION - General:

This report was prepared as a general reevaluation study of the American River Common Features Project, which was authorized by Section 101(a) (1) of the Water Resources Development Act (WRDA) 1996 (P. L. No. 104-303) and amended by Section 366 of WRDA 1999 (P. L. No. 106-53).

a. The effects of the 1986 storms raised concerns over the adequacy of the existing flood management system. These concerns led to a series of study authorizations and investigations into the need for additional reduction of flood risk for the Sacramento area. These investigations have resulted in the recommendation and subsequent authorization of the Folsom Dam Modification Project (now known as the Joint Federal Project or JFP), the Folsom Dam Raise Project, and incremental improvements to the network of levees along the American and Sacramento Rivers surrounding the city of Sacramento authorized in WRDA 1996 and WRDA 1999. Recommendations for levee improvements in the Natomas Basin are the subject of a Chief's Report signed in 2010 and are included in the Water Resources Reform and Development Act of 2014. The American River Common Features General Reevaluation Report (GRR) identifies the remaining flood risk to the city of Sacramento and the surrounding areas and alternatives to reduce this flood risk.

CECW-SPD
SUBJECT: American River Common Features Project, California – Deviation from the National Economic Development (NED) Plan

b. The identified NED plan involves the construction of levee improvement measures to address seepage, slope stability, erosion, and overtopping concerns identified for the Sacramento River levees, Natomas East Main Drainage Canal (NEMDC), Arcade, Dry/Robla, and Magpie Creeks. It includes erosion protection measures for the American River levees. American River seepage, stability, and overtopping issues were addressed in the WRDA 1996 and 1999 construction projects. Due to environmental, real estate, and hydraulic constraints within the American River North and South basins, the plan proposes to improve the levees within the existing footprint to the extent practical. The purpose of this would be to improve the flood risk management system to safely convey flows to a level that maximizes net benefits.

c. The LPP includes all the levee improvements contained in the NED Plan, except for 8 miles of flood walls or levee raises along the Sacramento River. The Sacramento Weir and Bypass would be widened to divert more flows into the Yolo Bypass. This would reduce the amount of levee raising required on the Sacramento River levees to address Hydraulic and Hydrologic uncertainty and meet the state's criteria for levee performance that would equal or exceed the 200 year water surface elevation plus 3 feet. As previously described under the NED, the levees along the American River, NEMDC, Arcade, Dry/Robla, and Magpie Creeks, would be improved to address identified seepage, stability, erosion, and height concerns. The levees along the Sacramento River would be improved to address identified seepage, stability, and erosion concerns as described under the NED. Due to environmental, real estate, and hydraulic constraints within the American River North and South basins, the majority of the levees would be fixed in place.

Widening of the Sacramento Weir and Bypass, and enhancing the flood system capacity, are key features of the system-wide improvements identified in the state of California's 2012 Central Valley Flood Protection Plan. Widening of the Sacramento Weir and Bypass reduces the river stage downstream of the American River confluence in the Sacramento and West Sacramento urban areas by diverting more water into the rural Yolo Bypass. The downstream stage reduction also decreases the risk to life safety and reduces flood damages to the rural communities located downstream of Sacramento. These communities include Clarksburg, Hood, Courtland, Walnut Grove, Ryde, and Isleton. Preliminary information from the Delta Islands Feasibility Study indicates existing expected annual damages for these communities to be around $10 million, and stage reductions would be expected to reduce damages by approximately 10% -30%.

The Central Valley Flood Protection Board and the Sacramento Area Flood Control Agency are the non-federal sponsors. They agree to pay the full incremental cost of the LPP above the NED Plan cost. The LPP is supported by the non-federal sponsors and the state of California because it allows the city of Sacramento and the surrounding

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SUBJECT: American River Common Features Project, California – Deviation from the National Economic Development (NED) Plan

areas to meet the requirements of Senate Bill 5 which stipulates that urban and urbanizing areas (with a population of 10,000 or greater) must achieve 1/200 Annual Chance Exceedence level of flood risk management in order to qualify for state funding of flood management projects.

4. DISCUSSION – NED vs. LPP:

The total costs, annual costs, annual benefits, net benefits and benefit to cost ratios for the NED and LPP are presented below.

	NED	LPP
Investment Costs:		
Flood Risk Management First Costs	$1,387,928,000	$1,547,833,000
Interest During Construction	361,375,000	489,447,000
Total	**1,749,303,000**	**2,037,280,000**
Annual Cost		
Interest and Amortization	74,573,000	86,849,000
OMRR&R	300,000	500,000
Total	**74,873,000**	**87,349,000**
Annual Benefits	414,553,000	410,928,000
Net Annual Flood Risk Management Benefits	339,680,000	323,579,000
Benefit to Cost Ratio	5.5	4.7

The LPP total first cost is about $160 million greater than the NED. The total federal cost contribution to the LPP will be limited to the federal share of the identified NED plan. The non-federal sponsor will be responsible for all operation, maintenance, repair, replacement and rehabilitation costs of the LPP.

5. RECOMMENDATION:

The LPP is recommended to further reduce the probability of catastrophic levee failure. The LPP achieves this by enhancing levee performance based on its ability to reduce the water surface elevation in the river adjacent to two urban areas, increase the regional flexibility of the flood management system, provide benefits to downstream communities in the form of reduced water surface elevations in the Sacramento River, and improve natural floodplain values by increasing the areas exposed to overbank flooding in the expanded bypass area. The LPP is a critical initial component of a larger regional plan under development by the state and local interests. The reduction in water surface elevation against these levees would reduce the probability of levee

CECW-SPD
SUBJECT: American River Common Features Project, California – Deviation from the National Economic Development (NED) Plan

failure in the urban areas. The results of such a levee failure would be catastrophic due to the minimal warning time for evacuation and deep flooding that would occur. The LPP reduces those consequences in alignment with the state of California Central Valley urban flood risk standards and long term flood risk management strategy. I request that you grant an exception to the requirement to recommend the NED plan to allow USACE to recommend the LPP for flood risk management for the American River Common Features General Reevaluation Report.

6. If you have any questions, please contact my action officer, Mrs. Pauline Acosta, Civil Engineer for the South Pacific Division Regional Integration Team, at (202) 761-4085.

STEVEN L. STOCKTON, P.E.
Director of Civil Works

Encls
1. SPD EndorsementLletter
2. SPK Exception Request
3. Non-federal Sponsor Letter Request
4. TSP Milestone MFR

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

MAR -9 2015

MEMORANDUM FOR DEPUTY COMMANDING GENERAL FOR CIVIL AND EMERGENCY OPERATIONS

SUBJECT: American River Common Features - Policy Waiver – Request to Deviate from the National Economic Development (NED) Plan

I am responding to a request from the Director of Civil Works that I grant an exception to the requirement to recommend the national economic development (NED) plan and instead allow the U.S. Army Corps of Engineers (Corps) to recommend Federal participation in the locally preferred plan (LPP) for the American River Common Features, California project.

My staff has reviewed the memorandum, the background information and the supporting documentation. The primary difference between the NED plan and the LPP is that the LPP includes all the levee improvements contained in the NED Plan, except for 8 miles of flood walls or levee raises along the Sacramento River. In place of those levee raises, the Sacramento Weir and Bypass would be widened to divert more flows into the Yolo Bypass. The LPP provides outputs and benefits similar to the NED plan within the study area but the LPP would result in lower water surface elevations against existing levees both within and beyond the study area.

The benefits provided by the 2 alternatives within the study area are very close. The costs and benefits of Alternatives 1 and 2 are still preliminary and will continue to be refined as the study progresses and the plan with the greatest average net annual benefits is re-affirmed. However, Alternative 1 has consistently achieved greater net benefits and, therefore, has been identified as the NED plan. The non-Federal sponsor supports the LPP and agrees to pay 100 percent of the LPP costs in excess of the NED plan. Therefore, I approve the requested policy exception to recommend the LPP provided that the sponsor shall have the sole responsibility for all additional costs above the NED plan.

If there are any questions, your staff may contact Mr. Henri Langlois, Project Planning and Review at (202) 761-0038.

jo-ellen darcy

Jo Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

CF: CECW-P

Table 1

****** TOTAL PROJECT COST SUMMARY ****** 3/4/2013

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE DRAFT FEASIBILITY REPORT, NED PLAN
PROJECT: ARCF GRR - Alt 1 **U. S. ARMY CORPS OF ENGINEER, SACRAMENTO DISTRICT**
LOCATION: CALIFORNIA **P.O.C.: JEREMIAH FROST, CHIEF, COST ENGINEERING SECTION**

Current MCACES Estimate Prepared: 1-Mar-2012 | **PROGRAM YEAR(BUDGET EC) 2014** | **TOTAL PROJECT COST (FULLY FUNDED)**
Effective Price Level (EPL): 1-Oct-2012 | **EFF. PRICE LEVEL DATE:1-Oct-2013** | **SPENT THRU: 1-Oct-2012**

WB NO.	Civil Works Feature\Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	PROJECT FIRST COST OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	TOTAL PROJECT COST (FULLY FUNDED) COST ($K)	COST ($K)	CNTG ($K)	FULLY FUNDED ($K)
		Contingency Applied To Remaining Cost Only								Sunk Cost Price Level (EPL): 1-Oct-2012			
	FEDERAL COSTS												
6	FISH & WILDLIFE FACILITIES	22,466	5,282		27,748		22,823	5,364	28,187	0	0	0	0
	ARN - Reaches D-I	660	150		810		672	150	822	0	0	0	0
	ARN - Reaches A-C	9,660	2,273		11,933		9,813	2,309	12,122	0	0	0	0
	ARS - Reaches A-C	10,886	2,561		13,447		11,059	2,600	13,659	0	0	0	0
	ARS - Reaches D-G	1,260	298		1,558		1,279	305	1,584	0	0	0	0
11	LEVEES & FLOODWALLS	723,798	164,143		887,941		734,817	166,739	901,556	26,215	0	0	0
	Natomas - Reaches B-H	71,017	10,542		81,559		71,724	10,709	82,433	26,215	0	0	0
	ARN - Reaches D-I	57,104	13,438		70,542		58,006	13,651	71,657	0	0	0	0
	ARN - Reaches A-C	82,837	19,492		102,329		84,145	19,800	103,945	0	0	0	0
	ARS - Reaches A-C	141,943	33,401		175,344		144,186	33,929	178,115	0	0	0	0
	ARS - Reaches D-G	370,897	87,270		458,167		376,756	88,650	465,406	0	0	0	0
18	CULT. RESRC PRESERV. (1	7,410	1,747		9,157		7,541	1,775	9,316	0	0	0	0
	Natomas - Reaches B-H	764	105		869		774	107	881	0	0	0	0
	ARN - Reaches D-I	687	134		821		700	136	836	0	0	0	0
	ARN - Reaches A-C	794	164		958		809	166	975	0	0	0	0
	ARS - Reaches A-C	1,253	256		1,509		1,276	260	1,536	0	0	0	0
	ARS - Reaches D-G	3,912	1,088		5,000		3,982	1,106	5,088	0	0	0	0
	SUBTOTAL FEDERAL & NON-FEDERAL CONSTRUCTION COSTS	753,674	171,172		924,846		765,181	173,878	939,059	26,215	0	0	0
1	LANDS & DAMAGES, Admin (2	9,325	469		9,794		9,597	485	10,082	0	0	0	0
	ARN - Reaches D-I	2,575	130		2,705		2,649	135	2,784	0	0	0	0
	ARN - Reaches A-C	525	27		552		540	29	569	0	0	0	0
	ARS - Reaches A-C	350	17		367		361	17	378	0	0	0	0
	ARS - Reaches D-G	5,875	295		6,170		6,047	304	6,351	0	0	0	0
30	PLAN/ENGINEERING/DESIGN	107,973	7,557		115,530		111,138	7,779	118,917	0	0	0	0
	Natomas - Reaches B-H	6,721	470		7,191		6,919	482	7,401	0	0	0	0
	ARN - Reaches D-I	8,631	604		9,235		8,884	622	9,506	0	0	0	0
	ARN - Reaches A-C	13,874	972		14,846		14,280	1,001	15,281	0	0	0	0
	ARS - Reaches A-C	22,924	1,604		24,528		23,596	1,652	25,248	0	0	0	0
	ARS - Reaches D-G	55,823	3,907		59,730		57,459	4,022	61,481	0	0	0	0
31	CONSTRUCTION MANAGE'MT	61,188	4,285		65,473		62,980	4,412	67,392	0	0	0	0
	Natomas - Reaches B-H	3,808	267		4,075		3,919	276	4,195	0	0	0	0
	ARN - Reaches D-I	4,891	344		5,235		5,035	353	5,388	0	0	0	0
	ARN - Reaches A-C	7,862	551		8,413		8,092	568	8,660	0	0	0	0
	ARS - Reaches A-C	12,992	909		13,901		13,373	935	14,308	0	0	0	0
	ARS - Reaches D-G	31,635	2,214		33,849		32,561	2,280	34,841	0	0	0	0
	SUBTOTAL FEDERAL & NON-FEDERAL CONTRIBUTION	932,160	183,483		1,115,643		948,896	186,554	1,135,450	26,215	0	0	0
	NON-FEDERAL CONTRIBUTION (-)	191,077	8,879		199,956		194,804	9,075	203,879	5,398	0	0	0
	TOTAL FEDERAL COSTS	**$741,083**	**$174,604**		**$915,687**		**$754,092**	**$177,479**	**$931,571**	**$20,817**	**$0**	**$0**	**$0**
	NON-FEDERAL COSTS												
1	LANDS AND DAMAGES	123,551	76,215		199,766		125,504	77,417	202,921	0	0	0	0
	ARN - Reaches D-I	13,888	8,237		22,125		14,108	8,366	22,474	0	0	0	0
	ARN - Reaches A-C	3,204	1,040		4,244		3,255	1,056	4,311	0	0	0	0
	ARS - Reaches A-C	1,730	467		2,197		1,757	475	2,232	0	0	0	0
	ARS - Reaches D-G	104,729	66,471		171,200		106,384	67,520	173,904	0	0	0	0
2	RELOCATIONS	75,589	16,393		91,982		76,690	16,654	93,344	5,811	0	0	0
	Natomas - Reaches B-H	30,108	5,692		35,800		30,491	5,783	36,274	5,811	0	0	0
	ARN - Reaches D-I	22,592	5,315		27,907		22,948	5,400	28,348	0	0	0	0
	ARN - Reaches A-C	2,385	561		2,946		2,423	570	2,993	0	0	0	0
	ARS - Reaches D-G	20,504	4,825		25,329		20,828	4,901	25,729	0	0	0	0
30	PLAN/ENGINEERING/DESIGN	10,466	733		11,199		10,632	746	11,378	0	0	0	0
	Natomas - Reaches B-H	3,645	254		3,899		3,702	259	3,961	0	0	0	0
	ARN - Reaches D-I	3,387	238		3,625		3,441	242	3,683	0	0	0	0
	ARN - Reaches A-C	358	25		383		364	25	389	0	0	0	0
	ARS - Reaches D-G	3,076	216		3,292		3,125	220	3,345	0	0	0	0
31	CONSTRUCTION MANAGE'MT	6,978	487		7,465		7,090	494	7,584	0	0	0	0
	Natomas - Reaches B-H	2,429	171		2,600		2,468	173	2,641	0	0	0	0
	ARN - Reaches D-I	2,260	156		2,416		2,296	159	2,455	0	0	0	0
	ARN - Reaches A-C	238	17		255		242	17	259	0	0	0	0
	ARS - Reaches D-G	2,051	143		2,194		2,084	145	2,229	0	0	0	0
	SUBTOTAL NON-FEDERAL (INCLUDES FED IRRIGATION SHARE)	216,584	93,828		310,412		219,916	95,311	315,227	5,811	0	0	0
	NON-FEDERAL CONTRIBUTION (+)	191,077	8,879		199,956		194,804	9,075	203,879	5,398	0	0	0
	Natomas - Reaches B-H	5,886	870		6,756		5,961	884	6,845	5,398	0	0	0
	ARN - Reaches D-I	5,799	1,431		7,230		5,902	1,454	7,356	0	0	0	0
	ARN - Reaches A-C	36,145	7,092		43,237		36,820	7,213	44,033	0	0	0	0
	ARS - Reaches A-C	65,059	13,168		78,227		66,259	13,388	79,647	0	0	0	0
	ARS - Reaches D-G	78,188	(13,682)		64,506		79,862	(13,864)	65,998	0	0	0	0
	TOTAL NON-FEDERAL COSTS	**$407,661**	**$102,707**		**$510,368**		**$414,720**	**$104,386**	**$519,106**	**$11,209**	**$0**	**$0**	**$0**
	TOTAL FEDERAL & NON-FEDERAL COSTS	**$1,148,744**	**$277,311**		**$1,426,055**		**$1,168,812**	**$281,865**	**$1,450,677**	**$32,026**	**$0**	**$0**	**$0**

**** TOTAL PROJECT COST SUMMARY(CONT'ED) ****

Current MCACES Estimate Prepared: 1-Mar-2012 Effective Price Level (EPL): 1-Oct-2012		ESTIMATED COST				PROGRAM YEAR(BUDGET EC) 2014 EFF. PRICE LEVEL DATE:1-Oct-2013 PROJECT FIRST COST				TOTAL PROJECT COST (FULLY FUNDED) SPENT THRU: 1-Oct-2012			
WB NO.	Civil Works Feature\Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	COST ($K)	CNTG ($K)	FULLY FUNDED ($K)
		Contingency Applied To Remaining Cost Only								Sunk Cost Price Level (EPL): 1-Oct-2012			

GENERAL NOTES

(1 Cultural Resources Preservation costs associated with mitigation and/or data recovery up to one percent of the total Federal cost are not subject to cost sharing.
(2 Federal administrative costs for non-Federal land acquisition.
(3 01 Account for Land and Damages cost are from Real Estates.

Table 2

ARCF GRR
ARS Reaches D-G
Subset of Costs for Alternative 0.5 (without levee raising)

Feature	Alternative 1 Cost ($1,000s)			Alternative 0.5 Cost ($1,000s)	
	Seepage, Stability, Erosion	Levee Raising 1/	Total	Seepage, Stability, Erosion	Total
6 Fed - Fish & Wildlife Facilities	1,503	55	1,558	1,503	1,503
11 Fed - Levees & Floodwalls	441,940	16,227	458,167	441,940	441,940
18 Fed - Cultural Resource Preservation	4,823	177	5,000	4,823	4,823
1 Fed - Lands & Damages	5,951	219	6,170	5,951	5,951
30 Fed - PED	57,615	2,115	59,730	57,615	57,615
31 Fed - CM	32,650	1,199	33,849	32,650	32,650
1 NF - Lands & Damages	165,137	6,063	171,200	165,137	165,137
2 NF - Relocations	24,432	897	25,329	24,432	24,432
30 NF - PED	3,175	117	3,292	3,175	3,175
31 NF - CM	2,116	78	2,194	2,116	2,116
	739,342	27,147	766,489	739,342	739,342

1/ Costs for levee raising based on quantities and construction cost equating to 3.67% of total construction cost and this percentage being used for all other accounts.

Table 3

Alternative 0.5 – Costs

BASIN	RISK SOURCE	FIRST COSTS	IDC	TOTAL COSTS	AVERAGE ANNUAL COSTS (AAC)	O&M	TOTAL AAC
		ALTERNATIVE 0.5: FIX IN PLACE-NO LEVEE RAISE (IN $1,000s, OCTOBER 2012 PRICE LEVEL, 50-YEAR PERIOD OF ANALYSIS, 3.75% DISCOUNT RATE)					
ARS	American	231,293	86,646	317,939	14,171	TBD	14,171
	Sacramento	739,342	234,786	974,128	43,417	TBD	43,417
	Total Basin	**970,635**	**321,432**	**1,292,067**	**57,588**	**0**	**57,588**
ARN	American	146,859	23,405	170,264	7,589	TBD	7,589
	Tributaries[2]	145,421	17,309	162,730	7,253	TBD	7,253
	Total Basin	**292,280**	**40,714**	**332,994**	**14,842**	**TBD**	**14,842**
GRAND TOTAL	**All Basins**	**1,262,915**	**362,146**	**1,625,061**	**72,430**	TBD	**72,430**

Alternative 1 – Costs

BASIN	RISK SOURCE	FIRST COSTS	IDC	TOTAL COSTS	AVERAGE ANNUAL COSTS (AAC)	O&M	TOTAL AAC
		ALTERNATIVE 1: FIX IN PLACE (IN $1,000s, OCTOBER 2012 PRICE LEVEL, 50-YEAR PERIOD OF ANALYSIS, 3.75% DISCOUNT RATE)					
ARS	American	231,293	86,646	317,939	14,171	TBD	14,171
	Sacramento	739,342	234,786	974,128	43,417	TBD	43,417
	Sac Raises	27,147	7,572	34,719	1,547	TBD	1,547
	Total Basin	**997,782**	**329,004**	**1,326,786**	**59,135**	**TBD**	**59,135**
ARN	American	146,859	23,405	170,264	7,589	TBD	7,589
	Tributaries[2]	145,421	17,309	162,730	7,253	TBD	7,253
	Total Basin	**292,280**	**40,714**	**332,994**	**14,842**	**TBD**	**14,842**
NATOMAS	All sources[3]	135,993	8,391	144,384	6,435	TBD	6,435
	Total Basin	**135,993**	**8,391**	**144,384**	**6,435**	**TBD**	**6,435**
GRAND TOTAL	**All Basins**	**1,426,055**	**378,109**	**1,804,164**	**80,412**	TBD	**80,412**

Table 4

****** TOTAL PROJECT COST SUMMARY ****** 3/4/2013

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE DRAFT FEASIBILITY REPORT, NED PLAN

PROJECT: ARCF GRR - Alt 2 — **U. S. ARMY CORPS OF ENGINEER, SACRAMENTO DISTRICT**

LOCATION: CALIFORNIA — **P.O.C.: JEREMIAH FROST, CHIEF, COST ENGINEERING SECTION**

Current MCACES Estimate Prepared: 1-Mar-2013 — **PROGRAM YEAR(BUDGET EC) 2014** — **TOTAL PROJECT COST (FULLY FUNDED)**

Effective Price Level (EPL): 1-Oct-2012 — **EFF. PRICE LEVEL DATE:1-Oct-2013** — **SPENT THRU: 1-Oct-2012**

WB NO.	Civil Works Feature\Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	PROJECT FIRST COST COST ($K)	CNTG ($K)	TOTAL ($K)	TOTAL PROJECT COST (FULLY FUNDED) COST ($K)	CNTG ($K)	CNTG ($K)	FULLY FUNDED ($K)
		Contingency Applied To Remaining Cost Only								Sunk Cost Price Level (EPL): 1-Oct-2012			
	FEDERAL COSTS												
6	FISH & WILDLIFE FACILITIES	22,466	5,506		27,972		22,823	5,591	28,414	0	0	0	0
	ARN - Reaches D-I	660	156		816		672	156	828	0	0	0	0
	ARN - Reaches A-C	9,660	2,369		12,029		9,813	2,406	12,219	0	0	0	0
	ARS - Reaches A-C	10,886	2,670		13,556		11,059	2,711	13,770	0	0	0	0
	ARS - Reaches D-G	1,260	311		1,571		1,279	318	1,597	0	0	0	0
11	LEVEES & FLOODWALLS	744,342	176,233		920,575		755,687	179,020	934,707	26,215	0	0	0
	Natomas - Reaches B-H	71,017	10,995		82,012		71,724	11,169	82,893	26,215	0	0	0
	ARN - Reaches D-I	57,104	14,015		71,119		58,006	14,237	72,243	0	0	0	0
	ARN - Reaches A-C	82,837	20,329		103,166		84,145	20,652	104,797	0	0	0	0
	ARS - Reaches A-C	141,943	34,834		176,777		144,186	35,385	179,571	0	0	0	0
	ARS - Reaches D-G	346,429	85,014		431,443		351,903	86,356	438,259	0	0	0	0
	Sac Bypass Widening	45,012	11,046		56,058		45,723	11,221	56,944	0	0	0	0
15	FLDWAY CONTRL & DIV STRUCTURE	54,713	13,427		68,140		55,577	13,640	69,217	0	0	0	0
	Sac Bypass Widening	54,713	13,427		68,140		55,577	13,640	69,217	0	0	0	0
18	CULT. RESRC PRESERV. (1	8,127	1,954		10,081		8,270	1,986	10,256	0	0	0	0
	Natomas - Reaches B-H	764	110		874		774	111	885	0	0	0	0
	ARN - Reaches D-I	687	140		827		700	142	842	0	0	0	0
	ARN - Reaches A-C	794	170		964		809	173	982	0	0	0	0
	ARS - Reaches A-C	1,253	266		1,519		1,276	270	1,546	0	0	0	0
	ARS - Reaches D-G	3,714	1,071		4,785		3,780	1,089	4,869	0	0	0	0
	Sac Bypass Widening	915	197		1,112		931	201	1,132	0	0	0	0
	SUBTOTAL FEDERAL & NON-FEDERAL CONSTRUCTION COSTS	829,648	197,120		1,026,768		842,357	200,237	1,042,594	26,215	0	0	0
1	LANDS & DAMAGES, Admin (2	9,575	482		10,057		9,854	499	10,353	0	0	0	0
	ARN - Reaches D-I	2,575	130		2,705		2,649	135	2,784	0	0	0	0
	ARN - Reaches A-C	525	27		552		540	29	569	0	0	0	0
	ARS - Reaches A-C	350	17		367		361	17	378	0	0	0	0
	ARS - Reaches D-G	5,875	295		6,170		6,047	304	6,351	0	0	0	0
	Sac Bypass Widening	250	13		263		257	14	271	0	0	0	0
30	PLAN/ENGINEERING/DESIGN	119,262	8,348		127,610		122,757	8,593	131,350	0	0	0	0
	Natomas - Reaches B-H	6,721	470		7,191		6,919	482	7,401	0	0	0	0
	ARN - Reaches D-I	8,631	604		9,235		8,884	622	9,506	0	0	0	0
	ARN - Reaches A-C	13,874	972		14,846		14,280	1,001	15,281	0	0	0	0
	ARS - Reaches A-C	22,924	1,604		24,528		23,596	1,652	25,248	0	0	0	0
	ARS - Reaches D-G	52,153	3,651		55,804		53,681	3,758	57,439	0	0	0	0
	Sac Bypass Widening	14,959	1,047		16,006		15,397	1,078	16,475	0	0	0	0
31	CONSTRUCTION MANAGE'MT	67,585	4,733		72,318		69,565	4,872	74,437	0	0	0	0
	Natomas - Reaches B-H	3,808	267		4,075		3,919	276	4,195	0	0	0	0
	ARN - Reaches D-I	4,891	344		5,235		5,035	353	5,388	0	0	0	0
	ARN - Reaches A-C	7,862	551		8,413		8,092	568	8,660	0	0	0	0
	ARS - Reaches A-C	12,992	909		13,901		13,373	935	14,308	0	0	0	0
	ARS - Reaches D-G	29,555	2,069		31,624		30,421	2,129	32,550	0	0	0	0
	Sac Bypass Widening	8,477	593		9,070		8,725	611	9,336	0	0	0	0
	SUBTOTAL FEDERAL & NON-FEDERAL CONTRIBUTION	1,026,070	210,683		1,236,753		1,044,533	214,201	1,258,734	26,215	0	0	0
	NON-FEDERAL CONTRIBUTION (-)	213,346	15,319		228,665		217,511	15,621	233,132	5,398	0	0	0
	TOTAL FEDERAL COSTS	**$812,724**	**$195,364**		**$1,008,088**		**$827,022**	**$198,580**	**$1,025,602**	**$20,817**	**$0**	**$0**	**$0**
	NON-FEDERAL COSTS												
1	LANDS AND DAMAGES	126,573	77,459		204,032		128,574	78,680	207,254	0	0	0	0
	ARN - Reaches D-I	13,888	8,237		22,125		14,108	8,366	22,474	0	0	0	0
	ARN - Reaches A-C	3,204	1,040		4,244		3,255	1,056	4,311	0	0	0	0
	ARS - Reaches A-C	1,730	467		2,197		1,757	475	2,232	0	0	0	0
	ARS - Reaches D-G	104,729	66,471		171,200		106,384	67,520	173,904	0	0	0	0
	Sac Bypass Widening	3,022	1,244		4,266		3,070	1,263	4,333	0	0	0	0
2	RELOCATIONS	85,907	19,630		105,537		87,171	19,942	107,113	5,811	0	0	0
	Natomas - Reaches B-H	30,108	5,936		36,044		30,491	6,031	36,522	5,811	0	0	0
	ARN - Reaches D-I	22,592	5,544		28,136		22,948	5,633	28,581	0	0	0	0
	ARN - Reaches A-C	2,385	585		2,970		2,423	594	3,017	0	0	0	0
	ARS - Reaches D-G	20,504	5,033		25,537		20,828	5,112	25,940	0	0	0	0
	Sac Bypass Widening	10,318	2,532		12,850		10,481	2,572	13,053	0	0	0	0
30	PLAN/ENGINEERING/DESIGN	12,014	841		12,855		12,204	856	13,060	0	0	0	0
	Natomas - Reaches B-H	3,645	254		3,899		3,702	259	3,961	0	0	0	0
	ARN - Reaches D-I	3,387	238		3,625		3,441	242	3,683	0	0	0	0
	ARN - Reaches A-C	358	25		383		364	25	389	0	0	0	0
	ARS - Reaches D-G	3,076	216		3,292		3,125	220	3,345	0	0	0	0
	Sac Bypass Widening	1,548	108		1,656		1,572	110	1,682	0	0	0	0
31	CONSTRUCTION MANAGE'MT	8,010	559		8,569		8,138	567	8,705	0	0	0	0
	Natomas - Reaches B-H	2,429	171		2,600		2,468	173	2,641	0	0	0	0
	ARN - Reaches D-I	2,260	156		2,416		2,296	159	2,455	0	0	0	0
	ARN - Reaches A-C	238	17		255		242	17	259	0	0	0	0
	ARS - Reaches D-G	2,051	143		2,194		2,084	145	2,229	0	0	0	0
	Sac Bypass Widening	1,032	72		1,104		1,048	73	1,121	0	0	0	0
	SUBTOTAL NON-FEDERAL (INCLUDES FED IRRIGATION SHARE)	232,504	98,489		330,993		236,087	100,045	336,132	5,811	0	0	0

**** TOTAL PROJECT COST SUMMARY(CONT'ED) ****

Current MCACES Estimate Prepared: 1-Mar-2013
Effective Price Level (EPL): 1-Oct-2012

PROGRAM YEAR(BUDGET EC) 2014
EFF. PRICE LEVEL DATE:1-Oct-2013

TOTAL PROJECT COST (FULLY FUNDED)
SPENT THRU: 1-Oct-2012

WB NO.	Civil Works Feature\Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	PROJECT FIRST COST COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	COST ($K)	CNTG ($K)	FULLY FUNDED ($K)
		Contingency Applied To Remaining Cost Only								Sunk Cost Price Level (EPL): 1-Oct-2012			
	NON-FEDERAL CONTRIBUTION (+)	213,346	15,319		228,665		217,511	15,621	233,132	5,398	0	0	0
	Natomas - Reaches B-H	5,886	905		6,791		5,961	920	6,881	5,398	0	0	0
	ARN - Reaches D-I	5,799	1,472		7,271		5,902	1,495	7,397	0	0	0	0
	ARN - Reaches A-C	36,145	7,403		43,548		36,820	7,530	44,350	0	0	0	0
	ARS - Reaches A-C	65,059	13,708		78,767		66,259	13,936	80,195	0	0	0	0
	ARS - Reaches D-G	67,611	(14,742)		52,869		69,092	(14,945)	54,147	0	0	0	0
	Sac Bypass Widening	32,846	6,573		39,419		33,477	6,685	40,162	0	0	0	0
	TOTAL NON-FEDERAL COSTS	**$445,850**	**$113,808**		**$559,658**		**$453,598**	**$115,666**	**$569,264**	**$11,209**	**$0**	**$0**	**$0**
	TOTAL FEDERAL & NON-FEDERAL COSTS	**$1,258,574**	**$309,172**		**$1,567,746**		**$1,280,620**	**$314,246**	**$1,594,866**	**$32,026**	**$0**	**$0**	**$0**

GENERAL NOTES

(1 Cultural Resources Preservation costs associated with mitigation and/or data recovery up to one percent of the total Federal cost are not subject to cost sharing.
(2 Federal administrative costs for non-Federal land acquisition.
(3 01 Account for Land and Damages cost are from Real Estates.

Table 5

Alternative 2

BASIN	LPP : SACRAMENTO BYPASS WIDENING (IN $1,000s, OCTOBER 2012 PRICE LEVEL, 50-YEAR PERIOD OF ANALYSIS, 3.75% DISCOUNT RATE)						
	RISK SOURCE	FIRST COSTS	IDC	TOTAL COSTS	AVERAGE ANNUAL COSTS (AAC)	O&M	TOTAL AAC
	American	232,845	110,958	343,803	15,323	TBD	15,323
	Sacramento	733,620	308,925	1,042,545	46,466	TBD	46,466
	Sac Bypass	170,525	30,895	201,420	8,977	TBD	8,977
ARS	**Total Basin**	**1,136,990**	**450,778**	**1,587,768**	**70,767**	**TBD**	**70,767**
	American	147,822	32,421	180,243	8,033	TBD	8,033
	Tributaries	146,239	17,406	163,645	7,294	TBD	7,294
ARN	**Total Basin**	**294,061**	**49,827**	**343,888**	**15,327**	**TBD**	**15,327**
	All sources	136,695	8,431	145,126	6,468	TBD	6,468
NATOMAS	**Total Basin**	**136,695**	**8,431**	**145,126**	**6,468**	**TBD**	**6,468**
GRAND TOTAL	**All Basins**	**1,567,746**	**509,036**	**2,076,782**	**92,562**	TBD	**92,562**

Table 6

ARCF GRR
Costs for Alternative 3

Civil Works Feature Description	ESTIMATED COST		
	COST ($K)	CNTG ($K)	TOTAL ($K)
ARN - Reaches A-C	114,000	20,000	134,000
ARN - Reaches D-I	112,000	26,000	138,000
ARS - Reaches A-C	185,000	33,000	218,000
Natomas - Reaches B-H	118,000	15,000	133,000
Sac Bypass Widening	157,000	28,000	185,000
Sac River Diversion Structure	122,000	61,000	183,000
Yolo Bypass, I-80 Railroad Relocation	277,000	55,000	332,000
Yolo Bypass, I-80 Causeway Improvement	475,000	95,000	570,000
Yolo Bypass, DWSC Overflow Weir	42,000	8,000	50,000
Yolo Bypass, DWSC Control Structure	144,000	29,000	173,000
Yolo Bypass, Pump Stations	5,000	1,000	6,000
	1,751,000	371,000	2,122,000

Table 7

****** TOTAL PROJECT COST SUMMARY ****** 2/1/2013

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE DRAFT FEASIBILITY REPORT, NED PLAN

PROJECT: ARCF GRR - Alt 3 — **U. S. ARMY CORPS OF ENGINEER, SACRAMENTO DISTRICT**

LOCATION: CALIFORNIA — **P.O.C.: JEREMIAH FROST, P.E., CHIEF, COST ENGINEERING SECTION**

Current MCACES Estimate Prepared: 17-Sep-2012
Effective Price Level (EPL): 1-Oct-2012

PROGRAM YEAR(BUDGET EC) 2013
EFF. PRICE LEVEL DATE:1-Oct-2012

TOTAL PROJECT COST (FULLY FUNDED)
SPENT THRU: 1-Oct-2011

WB NO.	Civil Works Feature\Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	PROJECT FIRST COST COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	COST ($K)	CNTG ($K)	FULLY FUNDED ($K)
		Contingency Applied To Remaining Cost Only								Sunk Cost Price Level (EPL): 1-Oct-2011			
	FEDERAL COSTS												
6	FISH & WILDLIFE FACILITIES	51,911	4,227		56,138		51,911	4,227	56,138	0	0	0	0
	ARN - Reaches D-I	660	126		786		660	126	786	0	0	0	0
	ARN - Reaches A-C	9,660	1,928		11,588		9,660	1,928	11,588	0	0	0	0
	ARS - Reaches A-C	10,886	2,173		13,059		10,886	2,173	13,059	0	0	0	0
	Yolo Bypass Improvements	30,705	0		30,705		30,705	0	30,705	0	0	0	0
11	LEVEES & FLOODWALLS	453,196	101,821		555,017		453,196	101,821	555,017	26,215	0	0	0
	Natomas - Reaches B-H	71,017	8,945		79,962		71,017	8,945	79,962	26,215	0	0	0
	ARN - Reaches D-I	55,357	11,056		66,413		55,357	11,056	66,413	0	0	0	0
	ARN - Reaches A-C	76,723	15,322		92,045		76,723	15,322	92,045	0	0	0	0
	ARS - Reaches A-C	136,705	27,300		164,005		136,705	27,300	164,005	0	0	0	0
	Sac Bypass Widening	58,273	11,637		69,910		58,273	11,637	69,910	0	0	0	0
	Yolo Bypass Improvements	55,121	27,561		82,682		55,121	27,561	82,682	0	0	0	0
15	FLDWAY CONTRL & DIV STRUCTURE	251,161	50,156		301,317		251,161	50,156	301,317	0	0	0	0
	Sac River Diversion Structure	196,448	39,230		235,678		196,448	39,230	235,678	0	0	0	0
	Sac Bypass Widening	54,713	10,926		65,639		54,713	10,926	65,639	0	0	0	0
18	CULT. RESRC PRESERV. (1	8,043	1,261		9,304		8,043	1,261	9,304	0	0	0	0
	Natomas - Reaches B-H	764	90		854		764	90	854	0	0	0	0
	ARN - Reaches D-I	668	111		779		668	111	779	0	0	0	0
	ARN - Reaches A-C	742	132		874		742	132	874	0	0	0	0
	ARS - Reaches A-C	1,210	213		1,423		1,210	213	1,423	0	0	0	0
	Sac River Diversion Structure	1,596	280		1,876		1,596	280	1,876	0	0	0	0
	Sac Bypass Widening	1,022	184		1,206		1,022	184	1,206	0	0	0	0
	Yolo Bypass Improvements	2,041	251		2,292		2,041	251	2,292	0	0	0	0
	SUBTOTAL FEDERAL & NON-FEDERAL CONSTRUCTION COSTS	764,311	157,465		921,776		764,311	157,465	921,776	26,215	0	0	0
1	LANDS & DAMAGES, Admin (2	3,775	191		3,966		3,775	191	3,966	0	0	0	0
	ARN - Reaches D-I	2,575	130		2,705		2,575	130	2,705	0	0	0	0
	ARN - Reaches A-C	525	27		552		525	27	552	0	0	0	0
	ARS - Reaches A-C	350	17		367		350	17	367	0	0	0	0
	Sac River Diversion Structure	75	4		79		75	4	79	0	0	0	0
	Sac Bypass Widening	250	13		263		250	13	263	0	0	0	0
30	PLAN/ENGINEERING/DESIGN	122,348	19,635		141,983		122,348	19,635	141,983	0	0	0	0
	Natomas - Reaches B-H	6,721	470		7,191		6,721	470	7,191	0	0	0	0
	ARN - Reaches D-I	8,369	585		8,954		8,369	585	8,954	0	0	0	0
	ARN - Reaches A-C	12,957	908		13,865		12,957	908	13,865	0	0	0	0
	ARS - Reaches A-C	22,138	1,550		23,688		22,138	1,550	23,688	0	0	0	0
	Sac River Diversion Structure	29,467	2,063		31,530		29,467	2,063	31,530	0	0	0	0
	Sac Bypass Widening	16,948	1,186		18,134		16,948	1,186	18,134	0	0	0	0
	Yolo Bypass Improvements	25,748	12,873		38,621		25,748	12,873	38,621	0	0	0	0
31	CONSTRUCTION MANAGE'MT	63,325	8,122		71,447		63,325	8,122	71,447	0	0	0	0
	Natomas - Reaches B-H	3,808	267		4,075		3,808	267	4,075	0	0	0	0
	ARN - Reaches D-I	4,743	331		5,074		4,743	331	5,074	0	0	0	0
	ARN - Reaches A-C	7,343	514		7,857		7,343	514	7,857	0	0	0	0
	ARS - Reaches A-C	12,545	879		13,424		12,545	879	13,424	0	0	0	0
	Sac River Diversion Structure	16,699	1,168		17,867		16,699	1,168	17,867	0	0	0	0
	Sac Bypass Widening	9,604	672		10,276		9,604	672	10,276	0	0	0	0
	Yolo Bypass Improvements	8,583	4,291		12,874		8,583	4,291	12,874	0	0	0	0
	SUBTOTAL FEDERAL & NON-FEDERAL CONTRIBUTION	953,759	185,413		1,139,172		953,759	185,413	1,139,172	26,215	0	0	0
	NON-FEDERAL CONTRIBUTION (-)	251,510	42,029		293,539		251,510	42,029	293,539	5,398	0	0	0
	TOTAL FEDERAL COSTS	**$702,249**	**$143,384**		**$845,633**		**$702,249**	**$143,384**	**$845,633**	**$20,817**	**$0**	**$0**	**$0**
	NON-FEDERAL COSTS												
1	LANDS AND DAMAGES	32,357	11,091		43,448		32,357	11,091	43,448	0	0	0	0
	ARN - Reaches D-I	13,888	8,237		22,125		13,888	8,237	22,125	0	0	0	0
	ARN - Reaches A-C	3,204	1,040		4,244		3,204	1,040	4,244	0	0	0	0
	ARS - Reaches A-C	1,730	467		2,197		1,730	467	2,197	0	0	0	0
	Sac River Diversion Structure	423	103		526		423	103	526	0	0	0	0
	Sac Bypass Widening	3,022	1,244		4,266		3,022	1,244	4,266	0	0	0	0
	Yolo Bypass Improvements	10,090	0		10,090		10,090	0	10,090	0	0	0	0
2	RELOCATIONS	266,178	11,756		277,934		266,178	11,756	277,934	5,811	0	0	0
	Natomas - Reaches B-H	30,108	4,831		34,939		30,108	4,831	34,939	5,811	0	0	0
	ARN - Reaches D-I	20,802	4,461		25,263		20,802	4,461	25,263	0	0	0	0
	ARN - Reaches A-C	2,024	404		2,428		2,024	404	2,428	0	0	0	0
	Sac Bypass Widening	10,318	2,060		12,378		10,318	2,060	12,378	0	0	0	0
	Yolo Bypass Improvements	202,926	0		202,926		202,926	0	202,926	0	0	0	0
30	PLAN/ENGINEERING/DESIGN	59,348	4,154		63,502		59,348	4,154	63,502	0	0	0	0
	Natomas - Reaches B-H	3,645	254		3,899		3,645	254	3,899	0	0	0	0
	ARN - Reaches D-I	3,119	220		3,339		3,119	220	3,339	0	0	0	0
	ARN - Reaches A-C	304	21		325		304	21	325	0	0	0	0
	Sac Bypass Widening	1,548	108		1,656		1,548	108	1,656	0	0	0	0
	Yolo Bypass Improvements	50,732	3,551		54,283		50,732	3,551	54,283	0	0	0	0
31	CONSTRUCTION MANAGE'MT	26,036	1,823		27,859		26,036	1,823	27,859	0	0	0	0
	Natomas - Reaches B-H	2,429	171		2,600		2,429	171	2,600	0	0	0	0
	ARN - Reaches D-I	2,080	145		2,225		2,080	145	2,225	0	0	0	0
	ARN - Reaches A-C	202	15		217		202	15	217	0	0	0	0

**** TOTAL PROJECT COST SUMMARY(CONT'ED) ****

Current MCACES Estimate Prepared: 17-Sep-2012
Effective Price Level (EPL): 1-Oct-2012

PROGRAM YEAR(BUDGET EC) 2013
EFF. PRICE LEVEL DATE:1-Oct-2012

TOTAL PROJECT COST (FULLY FUNDED)
SPENT THRU: 1-Oct-2011

WB NO.	Civil Works Feature\Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	PROJECT FIRST COST COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	COST ($K)	CNTG ($K)	FULLY FUNDED ($K)
		Contingency Applied To Remaining Cost Only								**Sunk Cost Price Level (EPL): 1-Oct-2011**			
	Sac Bypass Widening	1,032	72		1,104		1,032	72	1,104	0	0	0	0
	Yolo Bypass Improvements	20,293	1,420		21,713		20,293	1,420	21,713	0	0	0	0
	SUBTOTAL NON-FEDERAL (INCLUDES FED IRRIGATION SHARE)	383,919	28,824		412,743		383,919	28,824	412,743	5,811	0	0	0
	NON-FEDERAL CONTRIBUTION (+)	251,510	42,029		293,539		251,510	42,029	293,539	5,398	0	0	0
	Natomas - Reaches B-H	5,886	747		6,633		5,886	747	6,633	5,398	0	0	0
	ARN - Reaches D-I	5,580	1,264		6,844		5,580	1,264	6,844	0	0	0	0
	ARN - Reaches A-C	33,796	5,582		39,378		33,796	5,582	39,378	0	0	0	0
	ARS - Reaches A-C	62,794	10,868		73,662		62,794	10,868	73,662	0	0	0	0
	Sac River Diversion Structure	84,666	14,796		99,462		84,666	14,796	99,462	0	0	0	0
	Sac Bypass Widening	38,578	6,287		44,865		38,578	6,287	44,865	0	0	0	0
	Yolo Bypass Improvements	20,210	2,485		22,695		20,210	2,485	22,695	0	0	0	0
	TOTAL NON-FEDERAL COSTS	**$635,429**	**$70,853**		**$706,282**		**$635,429**	**$70,853**	**$706,282**	**$11,209**	**$0**	**$0**	**$0**
	TOTAL FEDERAL & NON-FEDERAL COSTS	**$1,337,678**	**$214,237**		**$1,551,915**		**$1,337,678**	**$214,237**	**$1,551,915**	**$32,026**	**$0**	**$0**	**$0**

GENERAL NOTES

(1 Cultural Resources Preservation costs associated with mitigation and/or data recovery up to one percent of the total Federal cost are not subject to cost sharing.
(2 Federal administrative costs for non-Federal land acquisition.
(3 01 Account for Land and Damages cost are from Real Estates.

Table 8

Combined w/New and Edited Features

Description	Construction	Right-of-Way	Environmental Mitigation	Project Development	Additional Compensation	All Features Total Cost	Needed for I-Street Diversion Mitigation	Costs for Mitigation
Fremont Weir Extension (Alternative B)	$27,831,600	$3,861,000	$3,608,000	$11,133,000	$0	$46,433,600	No	$ -
Upper Elkhorn Setback Levee	$149,741,900	$24,325,000	$10,947,000	$59,896,000	$0	$244,909,900	No	$ -
Lower Elkhorn Setback Levee	$129,346,100	$10,970,000	$11,733,000	$ -	$0	$152,049,100	No	$ -
Little Holland Tract - Liberty Island	$1,989,200	$1,050,000	$3,170,000	$795,000	$0	$7,004,200	No	$ -
Lower Egbert Tract	$74,209,500	$8,265,000	$25,537,100	$29,684,000	$0	$137,695,600	No	$ -
Sac R Bypass Setback Levee	$80,099,100	$3,260,000	$3,231,000	$32,040,000	$0	$118,630,100	No	$ -
Sac R Bypass Weir Extension	$156,790,830	$660,000	$1,748,000	$62,717,000	$0	$221,915,830	No	$ -
Shortline Railroad Relocation	$41,250,000	$3,660,000	$11,393,000	$16,501,000	$0	$72,804,000	No	$ -
Yolo Bypass West Levee	$555,434,500	$29,610,000	$83,477,000	$221,493,000	$0	$890,014,500	No	$ -
Sac River West Levee	$56,048,400	$3,507,000	$12,197,500	$22,419,500	$0	$94,172,400	No	$ -
I-80 Railroad Relocation	$243,536,600	$135,800	$3,527,800	$85,237,900	$0	$332,438,100	Yes	$ 332,438,100
I-80 Causeway Improvement	$418,655,300	$121,100	$5,271,300	$146,529,400	$0	$570,577,100	Yes	$ 570,577,100
DWSC Overflow Weir	$35,199,600	$235,000	$892,000	$14,080,000	$0	$50,406,600	Yes	$ 50,406,600
DWSC Control Structure	$120,044,100	$50,000	$1,740,000	$48,018,000	$3,000,000	$172,852,100	Yes	$ 172,852,100
Yolo East Pump Stations	$3,766,500	$403,500	$118,500	$1,318,500	$0	$5,607,000	Yes	$ 5,607,000
Yolo Bypass East Levee Improvements & DWSC Erosion Protection	$843,437,400	$40,020,000	$155,374,400	$337,375,200	$0	$1,376,207,000	No	$ -
						$4,493,717,200		$ 1,131,880,900

Table 9

Description	UOM	Quantity	ProjectCost
Summary			**122,161,762.85**
15 Floodway Control and Diversion Structures	**LS**	**1.0000**	**122,161,762.85**
15 01 Mob & Demob	**LS**	**1.0000**	**4,418,243.29**
15 02 Excavation	**LS**	**1.0000**	**5,834,078.51**
			35.4977
02 Channel/Bypass Channel Excavation	**CY**	**164,351.0000**	**5,834,078.51**
15 03 Phase 1 Internaly Braced Cofferdam	**LS**	**1.0000**	**5,952,570.42**
			48.4618
01 Sheet Piling PZ-35	**SF**	**64,000.0000**	**3,101,554.93**
			5.0705
02 Strut, Wales & Bracing	**LB**	**388,852.0000**	**1,971,679.57**
			200.7697
03 Tremie Slab	**CY**	**1,348.0000**	**270,637.62**
04 Dewatering System	**LS**	**1.0000**	**286,195.90**
			1,213.2413
05 Timber Guidewall (Temp Bypass)	**LF**	**216.0000**	**262,060.12**
			30,221.1409
06 7 Pile Dolphin Cluster (Temp Bypass)	**EA**	**2.0000**	**60,442.28**
15 04 Phase 2 Internaly Braced Cofferdam	**LS**	**1.0000**	**5,199,433.00**
			48.4614
01 Sheet Piling PZ-35	**SF**	**60,800.0000**	**2,946,454.39**
			5.1201
02 Strut, Wales & Bracing	**LB**	**338,802.0000**	**1,734,692.88**
			200.7697
03 Tremie Slab	**CY**	**1,156.0000**	**232,089.82**
04 Dewatering System	**LS**	**1.0000**	**286,195.90**
15 05 Phase 3 Internaly Braced Cofferdam	**LS**	**1.0000**	**4,003,368.77**
			48.4614
01 Sheet Piling PZ-35	**SF**	**48,000.0000**	**2,326,148.20**
			5.0567
02 Strut, Wales & Bracing	**LB**	**243,322.0000**	**1,230,408.87**
			200.7697
03 Tremie Slab	**CY**	**800.0000**	**160,615.80**
04 Dewatering System	**LS**	**1.0000**	**286,195.90**

Currency in US dollars

Description	UOM	Quantity	ProjectCost
			3,777,062.0294
15 06 Civil	**EA**	**1.0000**	**3,777,062.03**
			23.5198
01 Granular Fill	**CY**	**11,629.0000**	**273,512.05**
			40.7770
02 Embankment	**CY**	**24,822.0000**	**1,012,167.17**
			12.0399
03 Separator Geotextile	**SY**	**16,165.0000**	**194,624.46**
			43.3912
04 Bedding	**CY**	**5,389.0000**	**233,834.92**
			81.4000
05 36" Riprap	**TON**	**24,247.0000**	**1,973,705.22**
			2,008.3923
06 Fertilizing and Seeding	**ACR**	**5.0000**	**10,041.96**
			98.9703
07 9" Unreinforced Slope Paving	**SY**	**800.0000**	**79,176.24**
			30,050,135.1954
15 07 Foundation	**EA**	**1.0000**	**30,050,135.20**
			6,540,565.6796
U-Frame Structure	**EA**	**1.0000**	**6,540,565.68**
			15,487,857.6422
Tainter Gate	**EA**	**1.0000**	**15,487,857.64**
			8,021,711.8736
Tie-in Walls	**EA**	**1.0000**	**8,021,711.87**
15 08 Structure Concrete	**LS**	**1.0000**	**30,897,660.17**
U-Frame Structure	**LS**	**1.0000**	**6,531,399.43**
Tainter Gate	**LS**	**1.0000**	**22,184,844.37**
Tie-in Walls	**LS**	**1.0000**	**2,181,416.38**
15 09 Structural Steel	**LS**	**1.0000**	**11,175,409.54**
			7.5510
01 Tainter Gate	**LB**	**1,480,000.0000**	**11,175,409.54**
15 10 Mechanical	**LS**	**1.0000**	**2,621,000.10**
01 Tainter Gate Machinery	**LS**	**1.0000**	**2,621,000.10**
15 11 Electrical	**LS**	**1.0000**	**2,469,788.55**

Currency in US dollars

Description	UOM	Quantity	ProjectCost
			1,213.2413
15 12 Timber Wall Guides	**LF**	**312.0000**	**378,531.28**
			29,105.3674
15 13 Timber Pile Clusters (7 Pile)	**EA**	**3.0000**	**87,316.10**
			15,297,165.8973
15 14 Ground Improvement	**EA**	**1.0000**	**15,297,165.90**

Labor ID: LB11SACCO EQ ID: EP09R07 Currency in US dollars TRACES MII Version 4.0

Table 10

ARCF GRR
Costs for Alternative 4

Auburn Dam Cost Update

Item		Cost, $1,000s
Auburn Dam cost 1995		948,700
CCI 1994	422.71	
CCI 2014	767.89	
CCI	1.8166	
Auburn Dam cost 2014		1,723,397
Note, will round up to nearest hundred million dollars		1,800,000

Notes
CCI information from EM 1110-2-1304.
Auburn Dam cost from the American River Watershed, Supplemental Information Report, 1996.

Alternative 4 Total Cost Estimate

Item	Cost, $1,000s
Auburn Dam	1,800,000
Levee Improvement work from Alternative 1	1,426,055
Total	3,226,055

Table 11

ARCF GRR
Costs for Alternative 5

Item	Cost, $1,000s
Alternative 2 Levee Improvement and Sacramento Bypass Widening Construction	1,567,746
I Street Diversion Structure	183,000
Yolo Bypass Mitigation Work	1,131,000
Auburn Dam	1,800,000
Total	4,681,746

Table 12

ARCF GRR
Table 3-14 Backup

	Alternative						
	0.5 - Fix levees	1 - Fix & raise levees	2 - Fix levees and widen Sac Bypass	3 - I St Diversion	4 - Auburn Dam	5 - Maximum	6 - Non Structural
First Cost	1,262,915	1,426,055	1,567,746	2,122,000	3,226,055	4,681,746	N/A
Annual Costs	71,213	80,412	88,401	119,654	181,909	263,992	N/A
Annual Benefits	384,047	433,581	430,798	428,000	451,600	451,600	N/A
Net Benefits	312,834	353,169	342,397	308,346	269,691	187,608	N/A
B/C	5.4	5.4	4.9	3.6	2.5	1.7	N/A